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Editor's Note: Page 41 of the March Quarterly, part of the article by Dr. Ross Wedemeyer, is incorrectly set up and in order to remedy the error it has been reset on page 182 of this issue. Subscribers may tear out this page and paste it over the incorrect page in the March issue.

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The Doctoral Program in Physical Education

By JACK E. HEWITT

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(Submitted for publication January, 1946)

TWENTY higher educational institutions in the United States offer major specialization in physical education for the doctor's degree.[1, 2*] The doctoral program in physical education is relatively new. Work for this degree was first offered in 1924 by Teachers College, Columbia University, and the School of Education, New York University.[3] Even as late as 1932 there were only 8 institutions reported offering doctoral work in physical education. The Ph. D. degree was the only type of doctor's degree conferred until 1929 when Stanford University and the University of Pittsburgh both announced the new degree of Doctor of Education.[3]

Data for this study were obtained by a 1942-1943 catalogue survey of the institutions concerned, and verified by each of the schools. In addition, a questionnaire was enclosed for supplementary information not obtainable from catalogues. Personal visits were made to institutions in Washington, Oregon, Idaho, and California.

All standards recommended for the doctor's degree by national associations, accrediting agencies, boards of education, and outstanding authorities in the graduate field were tabulated and comparisons made with the institutions' requirements as they existed in 1942-1943.

TABLE I

INSTITUTIONS OFFERING A PHYSICAL EDUCATION MAJOR FOR THE DOCTOR'S DEGREES, 1942*

Institutions	*Degrees Conferred*
Boston University	Ed. D.
Cincinnati University	Ed. D.
George Peabody College for Teachers	Ph. D. in Education
Indiana University	Ed. D.; Ph. D. in Education
Louisiana State University	Ph. D. in Education
New York University	Ed. D.; Ph. D. in Education
Ohio State University	Ph. D.
Pennsylvania State College	Ed. D.; Ph. D.
Pittsburgh University	Ed. D.; Ph. D. in Education
Stanford University	Ed. D.; Ph. D. in Education; Ph.D.
State University of Iowa	Ph. D.

* These institutions and degrees conferred were reported in the *Research Quarterly*, May, 1942.

* Superior figures refer to bibliography at end of article.

This article is a partial abstract of one chapter of a doctoral dissertation referred to in the bibliography.

Syracuse University	Ed. D.; Ph. D. in Education
Teachers College, Columbia University	Ed. D.; Ph. D. in Education
University of Kentucky	Ph. D. in Education
University of Michigan	Ed. D.; Ph. D. in Education
University of Missouri	Ed. D.; Ph. D. in Education
University of Oregon	Ed. D. **; Ph. D. in Education**
University of Southern California	Ed. D. **
University of Texas	Ed. D.; Ph. D. in Education
University of Wyoming	Ed. D.; Ph. D. in Education

** Combined physical education and education major.

Purposes of Graduate Work at the Doctoral Level

Institutions were requested to state their purposes underlying the different types of doctor's degrees conferred and to rate their purposes as to importance from 1 highest to 4 lowest. Because there are only 20 institutions, the order of importance given to these listed purposes must not be considered too conclusive.

For the Ph.D. degree, 12 out of 18 institutions offering the physical education major indicated that "developing a high degree of specialized research in a given area of knowledge" is the most important single purpose for this degree. The development of research ability at the doctoral level is a generally recognized objective by prominent national associations and authorities in the graduate field. The American Council on Education,[4] the National Association of State Universities,[5] the Association of American Universities,[6] and the American Association of University Professors[7] all hold to the research objective for the Ph.D. degree. Likewise, Charles H. Thompson,[8] in his report of over 1,200 authorities in the graduate field, stated the importance of research ability for doctoral candidates.

Two additional aims next in significance for the Ph.D. degree mentioned by these institutions were "developing a high grade of scholarship" and "extending the boundaries of knowledge" (another way of stressing research). Seven institutions mentioned these two purposes, 4 stressed the "scholarship" objective, and 3 "extended boundaries of knowledge." Five other purposes mentioned for the Ph.D. might be considered of lesser importance because of lower ratings. These were: "developing a high degree of specialization within the field of interest," "training graduates to assume positions of greater service," "broadening cultural and professional preparation," "training of teachers, administrators, and directors of physical education," and "developing a philosophy of physical education."

Purposes listed by these institutions for the Ed.D. degree with a major in physical education were "preparation and training of teachers, administrators, and directors of physical education," "a high degree of specialization in the field of interest," and "scholarship." Five institutions considered "training of teachers" as the most impor-

tant aim, while 4 institutions each held that a "concentrated specialization" and "scholarship" were equally important. Five other purposes of lesser significance mentioned for this degree were "developing a philosophy of education" (physical education as functioning in education), "extending the boundaries of knowledge through research," "specialized research in a given area of interest," and "broadening cultural and professional preparation."

Many of the institutions now offering the professional doctor's degree in education hold it advisable to stress "knowledge of the field" rather than "research proficiency." This is done because it is felt that the administrator and the teacher can profit and contribute more as a teacher if the emphasis is away from pure research. However, four of the institutions offering the Ed. D. with a major in physical education do not hold to this philosophy. They agree with the Ph. D. authorities that "research proficiency" should be the main purpose whether the degree be the Ed. D. or the Ph. D. However, the practices expounded by these 4 institutions would appear to be in the minority especially when comparisons are made with the existing purposes listed by other professional schools offering this degree.

The pertinent aspects of the doctoral program will now be considered under three heads, i.e., admission, candidacy, and degree requirements.

Admission Requirements for the Doctorate

Most institutions differentiate between the requirements for entrance to the graduate school and those of candidacy for the degree.

Recommendations and approvals as an admission requirement.—Fifteen of the schools offering the doctorate required the candidate to secure the approval and recommendations of the major adviser or head of the department. These recommendations materially assist in weeding out unfit candidates.

Ability of the student.—The American Association of University Professors recommends that the student be endowed with unusual intellectual ability and with unequivocal capacity for research.[7]

Prerequisites.—Six institutions stated that they required the candidate to hold the master's degree or to have completed the equivalent of thirty semester-hours of graduate work beyond the bachelor's degree before allowing admission.

Pre-doctoral examinations.—Five institutions required some form of examination to be passed before the candidate was allowed to matriculate. One institution required the passing of an aptitude test; two, the passing of a preliminary examination; one, a general examination; and another, a test called the "pre-doctoral examination."

Foreign language as an admission requirement.—Only 2 schools

stated that they required the candidate to pass the foreign language requirements before matriculation. Both of these institutions offered the Ed. D. degree.

Residence as an admission requirement.—Nine institutions reported some form of residence in graduate work required before allowing matriculation for the doctorate. Two schools stipulated that at least twelve semester-hours be completed, the purpose of which was to judge the candidate's ability. Six institutions reported that the candidate must hold the master's degree or have completed an equivalent of 30 semester-hours of graduate work.

Teaching experience.—Two institutions offering the Ed. D. degree stated that the candidate must show proof that he has had some previous teaching or administrative experience in the field before they permit matriculation.

Admission to Candidacy Requirements

Seventeen institutions reported that matriculation in the graduate school does not constitute admission to candidacy for the doctorate. Most institutions set up specific requirements for candidacy which are as follows:

Recommendations and approvals.—In most cases recommendations and approvals have to be obtained from the department head or adviser. Twelve institutions indicated that for admission to candidacy they required approvals from the graduate school and the major department, the latter being either the school of education or the physical education department. This agrees with the recommendation made by the American Association of University Professors.[7] Four institutions reported that approvals were given by a special doctoral committee.

Examinations before candidacy.—Sixteen schools stated that they required the passing of some type of preliminary or qualifying examination before the student is admitted to candidacy. Six institutions gave a preliminary; 7, a qualifying; 2, a general examination; and 1, an aptitude test.

Administering a preliminary or qualifying examination seems to be a uniform practice in all institutions giving the doctorate and satisfies the recommendations made by the Association of University Professors.[7] Thirteen schools stated that this examination must be completed at least one year before conferring of the degree. The areas of knowledge which this test covers will be discussed under examinations.

Language requirements or the tools of research.—Nine institutions, reporting on the Ph. D. degree, required for candidacy a reading knowledge of French and German in the major field, or possibly some other language if it was related to the candidate's work or thesis. Seven schools stated that the language requirements have to be com-

pleted at least one year before the degree is conferred.

For the Ed. D. degree, 2 institutions indicated that they required a reading knowledge of two foreign languages, while 5 required the candidate to pass reading requirements in one language and in the tools of research (measurements and statistics in education). Ten institutions, however, reported they did not set up any language requirements for the Ed. D. degree. The general trend now in most education departments is not to require a reading knowledge of any foreign language, but to require the candidate to possess a comprehensive knowledge of statistics and measurements in education.

Other candidacy requirements.—Two institutions stated that before a student is admitted to candidacy an outline of the thesis project must be on file. Three schools made a close check on the candidate's research ability before allowing candidacy.

Degree Requirements

There are certain more or less standardized degree requirements which the institutions follow for the doctor's degree. These requirements seem to agree, in general, with those of the associations and agencies recommending standards for the doctorate.

Residence.—Seventeen schools reported that one academic year, preferably the last, must be spent in residence at the institutions conferring the degree. This requirement meets the recommendations made by the National Association of State Universities,[5] the American Association of University Professors,[7] and the Association of American Universities.[6] Nine schools specified no certain number of courses or credits which must be completed in residence. On the other hand, 11 specified a definite number of credits, the range being from eighteen to forty-five semester-hours. The mode reported is thirty semester-hours of residence credit.

Grades.—Considerable attention is given to grades by 16 institutions, which reported that the doctoral candidate must obtain "B" grades in all courses. Two institutions, however, allowed "C" grades or better to count toward the degree, while one considered the word "pass" as acceptable.

Units of credits.—Many institutions offering the doctorate stated in their bulletins and catalogues that no specific number of credits in semester-hours was set up and that the completion of the degree requirements differed with each candidate. Requirements are generally set forth after the adviser determines the experience and background of each candidate. Five institutions stated no semester-hour requirement, while 14 specified a range of sixty-six to ninety-four semester-hours. The National Association of State Universities[5] recommended a minimum of 75 semester-hours of graduate work (units beyond the bachelor's degree). Credit allowed for the dissertation

differs, 10 schools allowing a maximum of fifteen semester-hours and 6 specifying no credit. Credit for the dissertation ranged from zero to twenty semester-hours.

Languages.—Sixteen institutions offering the Ph. D. degree required a reading knowledge of two foreign languages (usually French and German) while 2 stated that the candidate had to pass one language examination and one test on the "tools of research" (measurements or statistics). The American Association of University Professors recommends a reading knowledge of French and German in the major field.[7]

For the Ed. D. degree, 5 schools required a reading knowledge of one foreign language plus an examination on the "tools of research" (measurements and statistics in education), while 2 required reading of two foreign languages. However, 10 schools offering the Ed. D. did not require the passing of any language requirement, but did require the candidate to possess a comprehensive knowledge of statistics and measurements.

Requirements in the major field:

1. Areas of specialization: Health and recreation were the two areas most closely related to the physical education field; 7 institutions reported that it was possible to specialize in one or a combination of these three fields. When the physical education major was a part of the School of Education curriculum, 13 schools indicated that it was possible to give considerable time to health, recreation, educational psychology, the curriculum in physical education or in education, the dance, and physical therapy. None of the agencies or associations which recommend criteria listed the areas of specialization, since they felt this was a matter to be worked out with the candidate and the adviser.[7]

2. Time: Nine schools specified no set time to be spent on the major and other areas, but indicated that this requirement had to be worked out with each candidate in accordance with his interests and desired field of concentration. Seven institutions recommended that approximately two-thirds of the time be given to the physical education field and one-third to other areas. One school stated that one-fourth of the time must be spent in physical education and three-fourths in other areas.

3. Units of credit in the major: Twelve institutions did not specify any number of semester-hours to be taken in the physical education major. Directors of these schools felt that this was an individual matter and dependent upon the experience and background of each candidate. However, three schools stated that they required at least sixty semester-hours in the major field.

Minor requirements.—Eight institutions did not specify any

minor to be taken, while 9 required at least one minor. In those requiring a minor, the average number of semester-hours was thirty.

Examinations.—The American Association of University Professors recommended that some form of preliminary or final examination be required.[7]

1. Preliminary or qualifying examination: Fifteen schools required a qualifying written examination and generally stated this test must be completed at least one year before the conferring of the degree. Four institutions made the qualifying examination both an oral and a written test, while one stated that it gave only the oral examination.

Ten schools gave the preliminary examination in both major and minor field, while 2 required a test in the major field only. Four schools tested the candidate in physical education, education, and other fields studied.

Ten institutions agreed that the purpose of the preliminary or qualifying examination was to "determine the promise and fitness of the candidate to do doctoral work." This examination is primarily diagnostic since it enables the adviser or committee to urge the candidate either to drop his doctoral work or to take additional courses so as to clear up deficiencies.

2. Final examination: Fourteen reported a comprehensive oral final examination and stated that this final test could cover all the candidate's course work and the dissertation. Generally, however, the oral final is concerned with the candidate's dissertation. Four schools indicated that they gave both a written and oral final examination.

Five institutions agreed that the purpose of the final examination is to show the "competency of the candidate in his major field" and the "ability of the candidate to defend his dissertation." Three stated that the candidate must "show his ability to apply knowledge of his field to other areas of education" and must also be able to "defend his dissertation."

Dissertation:

1. Doctor of Philosophy: For the Ph. D. degree 12 schools reported that the type of dissertation must be "research." It was found, however, that 2 of the institutions offering the Ph. D. in education accepted either a "research type" of thesis or an "evaluation and application of knowledge" type. The purpose expressed by the 12 schools was to show the candidate's research and scholarship ability, and in all cases, the dissertation should make a "definite contribution to the field of knowledge." A dissertation embodying the results of individual research is recommended by the Association of American Universities, the National Association of State Univer-

sities, and the American Association of University Professors.

2. Doctor of Education: The present study found that only 2 institutions offering the Ed. D. degree required the thesis to be of the "research type." Thirteen, on the other hand, indicated that the dissertation could be of "an evaluation and application of knowledge type" or a "research type." The purpose of the Ed. D. dissertation is generally agreed upon by these schools, namely, that the candidate should "show his ability to organize and to test educational theory and practice through application to actual school situations." In these instances the dissertation is usually of a functional nature and applicable to some part of the educational system.

Years Allowed to Complete the Degree

There is little consistency in setting up a requirement as to the number of years necessary to complete the doctorate. The range as reported by 16 institutions was from three to ten years. The mode was five years. One institution gave "unlimited time" to complete the work. The National Association of State Universities recommends five years.[5]

Agency Controlling the Degree

For the degree of doctor of philosophy in education, it was found that the school of education in 8 schools controlled this degree, while a like number indicated that the School of Education had jurisdiction over the Ed. D. degree; however, in 5 institutions the graduate school controlled both the Ed. D. and the Ph. D. in education. When the Ph. D. degree is given in physical education, 4 of the 5 reported that the graduate school exercised this authority.

Migration and Transfer of Credit

Much has been said in favor of the plan of allowing students to migrate from one institution to another. It is generally conceded that the student benefits a great deal, both in experience and in breadth of training by taking work for his doctorate in two or more institutions. Many schools now have restrictions concerning the granting of more than two degrees to an individual. Without doubt the student gains much from personal contact with different authorities in his field, even at the cost of not having all his work accepted by the institution conferring the final degree. The Association of University Professors recognizes the value of migration and has duly recommended that institutions of equal rank accept credits at par value.[7]

Correspondence and Summer-Session Work

The Committee of the American Association of University Professors[7] disapproves the acceptance of correspondence work as satisfying any part of the requirements for the doctor's degree. This same association in discussing summer-session work recommends that, when graduate courses are conducted in summer session on the same plane as work in the regular session, these courses shall be duly recognized as part of the preparation for the doctorate.

SUMMARY AND DISCUSSION

The doctoral program in physical education is relatively new, having been inaugurated in 1924. The Ph. D. degree was first conferred in 1926 by two institutions in New York. Even as late as 1932 there were reported only 8 schools in the United States offering a major in physical education for the doctor's degree, but by 1942 this number had increased to 20.

In 1929 the new degree of doctor of education was made available to physical education. The Ed. D. degree is a professional degree in education and is analogous in many ways to other professional degrees in science, jurisprudence, engineering, etc. In general, for this degree, the emphasis is toward a mastery of subject matter in the broad fields of education, with the solution of practical problems by proven methods and techniques. The degree has grown out of the recently increased demand for highly trained educational administrators, supervisors, and teachers rather than for research technicians.

This study shows that there are three types of doctor's degrees available for major students in physical education. They are the Ph. D. degree in physical education, the Ph. D. degree in education, and the Ed. D. degree in education. Of the 20 institutions mentioned above 13 offer the Ph. D. in education; a like number, the Ed. D. in education; and only 5, the Ph. D. in physical education. Approximately 85 percent of all doctor's degrees and 51 percent of all master's degrees with a physical education major are conferred by schools of education. Departments of physical education by themselves give 45 percent of the master's degrees and only 4 percent of the doctor's degrees.[2] These findings are similar to those mentioned in Ruth Elliott's report of 1927 in which she showed that in 16 out of 18 state universities the professional curriculum in physical education comes under the jurisdiction of the school of education.[9] There are three or four reasons which may account for this condition. In the first place, before World War II the demand for advanced specialists in physical education was slight. The bachelor's degree has for many years been accepted by the secondary schools as sufficient evidence

of preparation and only recently have we seen the necessity of having a master's degree for teaching in the high school and the doctor's degree for the college. Because the physical education profession was so new and because there was insufficient demand for highly trained personnel, schools or departments of physical education found it difficult to organize a separate graduate major and have it duly recognized by their graduate schools. The most natural procedure was to set up the first few graduate courses under some other organized school. The department, school, or division with which physical education was most nearly related, administratively, was the school of education. Both schools have always had somewhat identical purposes, *viz.*, the training of teachers. This probably more than anything else helped to bring about the fusion of these schools at the graduate level. In addition, there are perhaps one or two other reasons. One is that most major schools of physical education have not offered enough graduate courses within their own department for the completion of the master's degree. Students were forced to complete their master's requirements by entering other fields, and many of them found it advisable and profitable to enter education. This retarded graduate schools of physical education and built up departments of education. Another factor is that physical education staffs in the past have had inadequate training and experience to enable them to teach in most graduate schools. More and more graduate schools are insisting that staff members, to be bona fide teachers at this level, must possess the doctor's degree or have equivalent training and experience.

There is considerable uniformity in most of the institutions concerning the formal standards for the doctor's degree. Standards recommended for higher degrees by national associations and authorities in the graduate field are generally met by the 20 institutions under consideration here. Institutions differentiate between admission to the graduate school and admission to candidacy for the degree. There is a general agreement on requiring one year of residence, usually the last, and three years of graduate work beyond the bachelor's degree as minimum requirements for the doctorate.

All the institutions in this survey reported that they required some form of a preliminary or qualifying examination, the purpose of which is to "test the fitness of the candidate to do doctoral work." This examination is generally diagnostic. As a rule, it must be completed at least one year before the conferring of the degree.

Regarding the purpose of training for the Ph. D. degree, the responses to the questionnaire listed: "developing a high degree of specialized research in a given area of knowledge," "developing scholarship of a high order," and "extending the boundaries of knowledge" (another way of stressing research) as principal aims.

Lesser objectives mentioned were: "developing a high degree of specialization within the field of interest," "training graduates to assume positions of greater service," "broadening cultural and professional preparation," "training of teachers, administrators, and directors of physical education," and "developing a philosophy of physical education."

Purposes listed for the doctor of education were "preparation and training of teachers, administrators, and directors of physical education," "developing scholarship," and "developing a specialization within the field of interest." Aims of lesser importance were: "developing a philosophy of education" (physical education as functioning in education), "specialized research in a given area of knowledge," "contribution to the field of knowledge through research," and "cultural and professional preparation." Institutions agree in general to the above mentioned purposes for both the Ed. D. and the Ph. D. degrees, although differences do exist as to the weight of importance given to each aim.

A reading knowledge of two foreign languages is almost a uniform requirement for the Ph. D. degree, but it is not always required for the Ed. D. degree. In thus survey of the Ed. D., 2 schools required a reading knowledge of two foreign languages, whereas 5 institutions required a knowledge of one language and a comprehensive test on measurements and statistics in education. The latter is generally a standard requirement for the Ed. D. in all institutions.

Institutions are quite evenly divided in the matter of counting credit (semester-hours) for the doctorate. Many feel that the doctor's degree should not be a matter of completing a specified number of credits, but that the work should be related more to the students' experience, background, and achievement. For the institutions requiring a specified number of semester hours' credit, the average is ninety semester hours of graduate work above the bachelor's degree. The National Association of State Universities recommends a minimum of seventy-five graduate credits beyond the bachelor's degree.

The general trend in respect to grades is to require students to achieve "B" or better grades in all courses at this advanced level.

The dissertation is required for both degrees in all institutions. For the Ph. D. degree the dissertation is supposed to be a definite piece of individual research and to make a contribution to the field of knowledge. For the Ed. D. degree it may be of the research type, but often the problem required is one that is applicable to some area of education. The majority of dissertations for the Ed. D. degree have been concerned with the testing and the application of educational theories and practices to some phase of the school system.

The final examination is required in all the institutions; the purposes stated are that the candidate "defend his thesis," "show

competency in his major field," and "be able to apply knowledge within his field of specialization to other areas of education."

Since the doctor of education is a professional degree with emphasis on functional and practical applications, two years of teaching or administrative experience are usually required as a prerequisite.

On the whole, the future of graduate work in physical education looks very promising. There have been blunders and inadequacies in the past, to be sure, but these are a part of any growing program and are rapidly being rectified. The demand for trained teachers and specialists in the field is increasing daily. With World War II over and with record enrollments in sight, some graduate schools will have more students than they can handle. Courses in the future will be better and will be taught more scientifically because of the advancement of knowledge through research and experimentation. The graduate staffs will have more experience and will be better trained for graduate work. Forty-six percent of the staff who now hold the master's degree were (in 1942) "in training" for their doctorate, while 73 percent of the graduate faculty were reported as completing the work for their master's degrees.[10]

Even though physical education at the graduate level has seen fit in the past to fuse itself in many instances with the school of education, it is the writer's belief that more schools of physical education will eventually draw away from this dominance. Five graduate schools of physical education now control their own doctor's degrees and have no connection with the school of education. This the writer believes is a desirable trend, for if physical education is ever to become an established and recognized profession, it must stand on its own feet and maintain its own standards.

Before closing, one or two criticisms of graduate work for the doctor's degree are in order. In the first place, many institutions still adhere to the traditional, obsolescent practice of requiring their doctor's candidates to complete a certain number of courses, attend a certain number of classes, attain certain grade averages, etc., with the result that students lose sight of the larger and more important objectives. Work at the doctoral level should not involve too many mechanical routines. Formal requirements should be held down to a minimum. Students should be put more on their own resources with less spoon-feeding, direction, and dictation, if initiative and independent action are to blossom forth. Work at this advanced level is supposedly geared to awaken an intellectual curiosity, to develop powers of insight, reflection, judgment, and reason. If scholarship is an important aim of the doctorate, then the candidate must be put more on his own mettle, and he must be allowed all possible freedom to demonstrate his ability to think clearly, to disseminate infor-

mation, and to interpret knowledge within his specialized field.

Many institutions are in a quandary as to what will be done in the future with the language requirement. Much of the criticism against this formal standard has been justified. Some institutions hold that the present language requirement is a farce when candidates are allowed to cram a smattering of French and German and then quickly stumble through the reading test while they still remember a little. In such instances, it is a rare student indeed who can read French and German fluently one or two years after receiving his degree. Perhaps the solution to this criticism, if the language requirement is considered essential and important, is either to teach the languages thoroughly or to give them up entirely.

It is unfortunate that the granting of the doctor's degree often means the end of all search and research for the student. Too often the dissertation is the candidate's "finis" for research, whereas it should provide the stimulus for continued experimentation. The obstacles for a higher degree are often so great and so distasteful that the driving force is dulled to such an extent that the student fails to live an active, eager, and fertile intellectual life afterwards. Such a condition does not speak well for our higher institutions. The time is ripe to take stock of our graduate offerings and practices.

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Action of Drugs on Efficiency of Swimmers

By JOHN HALDI and WINFREY WYNN
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(Submitted for publication, March, 1946)

THE influence of training on speed and endurance in such muscular activities as running or swimming, which require both a high degree of muscular coordination and physical stamina, is fairly well understood, and the improvement that occurs with practice presents no particular difficulties from the physiological point of view. In the course of training one learns how to eliminate irrelevant and useless movements, while at the same time cardiovascular and respiratory adjustments are brought about which increase one's capacity for work. Maximum power is thereby gradually achieved with a minimum expenditure of energy and the energy reserves last longer.

In the early stages of training the improvement in performance is usually fairly rapid; then the rate of improvement gradually tapers off to a plateau and the performance remains fairly constant from day to day or from week to week. However, optimum performance cannot be duplicated in each successive trial. In this respect the human organism differs from a purely mechanical machine. Were it otherwise the outcome of highly competitive contests could be predicted with perfect accuracy.

This fact poses questions of poignant physiological interest. What, for example, is the physiological basis of diurnal variations in speed in swimming and in the decrement of speed during swimming in the trained individual? Are they due to variations in the metabolic processes, to differences in the irritability and conductivity in the central nervous system, or to day-to-day changes in the efficiency of the respiratory or cardiovascular systems?

In previous studies[1, 2*] it was found that performance in swimming a hundred-yard sprint (which was selected as a representative form of short, strenuous exercise) was not affected by the amount or kind of food consumed several hours before exercise. This would seem to indicate that diurnal variations in performance are not related to variations in metabolic processes. The present study was undertaken to determine whether the initial speed in swimming and the decrement in speed while swimming a hundred-yard sprint are affected by certain drugs which stimulate the central nervous and cardiorespiratory systems.

* Superior figures refer to numbered bibliography at end of article.

PROCEDURE

Twelve healthy young men who were enrolled in the Navy V-12 program at Emory University served as volunteer subjects. They all had taken part in a similar experiment which was conducted over a period of eight weeks immediately antecedent to the inauguration of the present study, and were accordingly in training and accustomed to the procedure. There was strikingly manifest in the group a spirit of cooperation and willingness to follow instructions to the letter. None of the subjects was an expert swimmer, but all were eager to exert themselves to the utmost with the purpose in mind of breaking their former records.

A specially prepared meal was served in the mess hall at 4:45 P.M., the composition of which is described elsewhere.[1] The meal provided 1,050 calories, 13 percent of which was derived from carbohydrate, 37 percent from protein, and 50 percent from fat. Swimming performance has been found to be the same after this meal as after a lighter one of 550 calories.[2] The heavier meal was selected as it gave a sense of satiety to the subjects for the remainder of the day. The living habits of the subjects were uniform except for the weekends. To safeguard against a possible effect of the changes in daily habits at this time the experiments were conducted only on Tuesdays and Thursdays.

Approximately an hour and a half before swimming the subjects swallowed a capsule containing either a placebo (200 mgm. sucrose); 100 mgm. metrazol; or 5 mgm. benzedrine sulfate (racemic amphetamine sulfate); or 250 mgm. caffeine alkaloid. None of the subjects knew what was in the capsules. In succeeding sets of experiments the order of administration was changed from that of the preceding set.

In view of the possibility that swimming performance might be related to the blood sugar concentration which in turn might conceivably be affected by the action of the drugs, blood samples for sugar analysis were obtained before and after swimming. The subjects reported at the swimming pool at 7:00 P.M., and the first blood samples were taken by finger puncture shortly thereafter. The subjects then "warmed up" by swimming slowly a distance of a hundred yards. This was followed by a short rest period and then each swimmer was put through the test in successive order. He toed the mark as in a swimming meet and at a given signal dove into the pool and swam 100 yards as fast as possible. The swimming coach and one of the authors walked alongside the pool continually urging him to go faster. Each lap of 33-1/3 yards was timed in split seconds. At the conclusion of the swim 3 to 5 minutes were allowed for the swimmer to regain his wind and then another blood sample was drawn. Analysis of the blood for its sugar content

TABLE I

SWIMMING TIME AND BLOOD SUGAR CONCENTRATION AFTER THE ADMINISTRATION OF METRAZOL, BENZEDRINE AND CAFFEINE*

Material ingested before swimming	*Time*				*Drop-Off*		*Blood Sugar*	
	1st 33-1/3 yards (*seconds*)	2nd 33-1/3 yards (*seconds*)	3rd 33-1/3 yards (*seconds*)	100 yards (*seconds*)	2nd 33-1/3 yards (*seconds*)	3rd 33-1/3 yards (*seconds*)	Before swim *mgm. %*	After swim *mgm. %*
Placebo	21.0	26.3	30.3	77.6	5.3	9.3	130	142
Metrazol 100 mgm.	20.9	26.4	30.5	77.7	5.5	9.6	130	143
Benzedrine 5 mgm.	21.1	26.4	30.7	78.2	5.3	9.6	121	145
Caffeine 250 mgm.	20.9	26.1	30.5	77.5	5.2	9.6	120	139

* Each value in the table is an average of 36 experiments.

was made by the Hagedorn-Jensen procedure.[3]

RESULTS

A summary of the experimental data which is presented in Table I shows that metrazol, benzedrine, and caffeine had no effect (a) on the time required for swimming the total distance (or any of the three laps), or (b) on the drop-off in the second and third laps. The time that elapsed in swimming 100 yards in the experiments with benzedrine was 0.6 seconds less than after taking the placebo, but this difference was not statistically significant. The blood sugar values before swimming were at approximately the same level as those found two to three hours after the heavy meal in former experiments.[2] The blood sugar level after swimming was practically the same in all the experiments, but was higher at this time than it was immediately before exercise. These results are in conformity with those obtained previously in similar studies.[1, 2]

DISCUSSION

While no attempt was made to measure the action of the drugs on our subjects with respect to stimulation of the central nervous system, cardiac output, respiratory volume, and metabolic processes, it is reasonable to suppose that definite effects were obtained. Administration of the dose of caffeine employed in our experiments has been found to produce cortical stimulation, giving one a keener appreciation of sensory stimuli and allaying drowsiness and fatigue. Motor activity is increased and reaction time diminished.[4, 5] There is an increase in cardiac output[6] persisting for several hours.[7] Respiratory volume also is increased and there is a definite stimulation of metabolic processes.[6, 8]

Metrazol acts primarily on the central nervous system, nonconvulsant doses having little or no effect on the cardiovascular system of anaesthetized man.[9] It has an excitant action on both sensory and motor neurons[11] which might continue for over an hour.[12]

Benzedrine likewise stimulates the central nervous system, particularly the cortex. In normal individuals therapeutic doses of the drug produce no detectable effect on the rate and depth of respiration or on vital capacity. Cardiac output is not increased nor is the velocity of the blood flow accelerated.[12] In most of the studies reporting cortical stimulation 10 mgm. or more of the drug was administered. The smaller dose of 5 mgm. was chosen for our experiments because of the necessity of exercising precaution against prolonged wakefulness which might affect the academic work and other duties of the subjects. It seemed reasonable to

assume that a stimulating action would be produced by 5 mgm. Several competent observers had informed us that in their personal experience they had observed definite effects from this amount of the drug. In the literature occasional references may be found substantiating this observation.[13, 14]

Different results from these that we obtained from swimmers have been reported in studies on less severe and more protracted exercise. Caffeine has been found to increase work output of subjects pedaling a bicycle ergometer at the rate of 1,235 kilogram meters per minute for 4 or 5 minutes.[15, 16] In contrast to these observations, however, and in conformity with ours, it had no effect on performance of runners in a 100-meter dash.[17] Metrazol is said to give greater endurance and to lessen the symptoms of fatigue in walking tours, ski-running, bicycle races, and other forms of protracted exercise.[14, 18] Benzedrine has been found to abolish fatigue or retard its onset[19] and to increase the work output of a subject pedaling a bicycle ergometer.[20] From these observations as compared with ours, it would appear that in short, exhausting exercise the underlying causes of fatigue and of the limitation of work output are probably different from those that prevail in less severe exercise of longer duration.

CONCLUSIONS

Administration of 100 mgm. metrazol, 5 mgm. benzedrine, or 250 mgm. caffeine alkaloid approximately one hour before swimming had no effect on speed or the rate of deceleration of speed in swimming a 100-yard sprint.

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Body Weight And The Incidence of Flat Feet

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INTRODUCTION

IT has long been assumed that excess body weight contributes to the flattening of the foot. Physiological evidence on the extension of living tissue and its breakdown at the limit of elasticity by the application of weight has been invoked as proof. Howell records that if "the weight is increased until it is sufficient to overcome the elasticity of muscle" deformation takes place and that "the amount of deformation exhibited by a muscle or other living tissue placed under a stress varies with the time that the stress is allowed to act."[1] It may be deduced from the above that stress in the form of body weight exerted over a period of time may deform the ligaments supporting the bones of the foot.

Morton emphasizes deficiency in the first metatarsal bone as the cause of flat foot.[2] Although he does not explicitly relate foot deformity to body weight, however, he does make frequent references implying a relationship, as in the statement: "As body weight became borne increasingly by the outer portion of the foot, the need for divergence of the hallux was correspondingly reduced."[3, 4]

Without indicating the supporting evidence, Lake states that flat foot in the adolescent is "associated with rapid increase in weight and structure . . ." and that the adult type of flat foot "occurs at the period of middle age, when weight tends to increase . . ."[5]

From the above it should follow that flat foot will occur more frequently among the overweight. But does it? And does flat foot also occur more frequently among heavy people regardless of whether they are overweight, by whatever standard that elusive concept is judged?

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1 W. H. Howell. *A Textbook of Physiology.* 9th ed. Philadelphia: W. B. Saunders, 1925. P. 22.
2 Dudley J. Morton. *The Human Foot.* New York: Columbia University Press, 1935. Pp. 153-158 and 172-174.
3 Morton, *op. cit,* pp. 63, 64, 117, 207, 225, *et al.*
4 *Ibid.*, p. 64.
5 Norman C. Lake. *The Foot.* 2nd ed. Baltimore: William Wood & Co., 1938. Pp. 162 and 163.

PURPOSE

This study was undertaken in an effort to verify the relationship between body weight and flat feet and is restricted to the structural deformity in the longitudinal arch of the foot, commonly called flat foot and technically, "pes planus." The study is not concerned with foot function or weak feet inasmuch as flat foot is not necessarily accompanied by impairment of function or by weakness of the foot.

METHOD

The data were obtained from the medical examination records of 4,322 entering freshmen at Brooklyn College over a period of five years. The measurements used were the age, height, and weight of each student and the examining physicians' judgment of the condition of the feet. The measurements of height and weight were made by one trained physical education instructor throughout the five-year period. The weights were taken to the quarter of a pound and the height to the tenth of an inch. The judgment of the condition of the feet was made by a physician. Although several different doctors were involved, the same ones examined the students over the five-year period and adopted a uniform method of diagnosis.

The method of conducting the foot examination and the criteria used by the physicians to determine flat foot follows. After walking on a dust-covered floor, the student stood erect with his back to the examiner. The student was then directed to stand on one foot, the other leg flexed at the knee with the dust-covered sole of the foot held up for inspection. This procedure was repeated on the other foot. The physician examined for loss of or deviation from the normal "C" curve of the longitudinal arch. Diagnosis was further checked by inspecting for loss of normal space between the floor and the height of the longitudinal arch, abduction of foot from midline position, and pronation of foot as determined by deviation of the line of the Achilles tendon.

If either foot or both were diagnosed as flat, the student was placed in the flat-foot group. All others were placed in the normal group.

A check on relative frequencies of diagnosis of flat foot by the different doctors revealed no marked differences.

Other methods for the determination of flat-footedness and of deficiencies in foot function have been described by Danford,[6] Clarke,[7] Cureton,[8] Morton,[9] Lake,[10] Dickson and Dively,[11] and others. The orthopedists generally use a battery of criteria and favor the use of dorsoplantar x-rays in all examinations.[9, 10, 11] Morton leans heavily for diagnosis on the kinetograph and staticometer and is

very critical of the "customary method of making prints of the soles of the feet" as failing "to show how this (body) weight is distributed."[12] Lake favors the use of a pedograph with which a sort of half-tone footprint is obtained.

Clarke described a pedograph and a system of angular measurements of footprints which supply an objective measurement of the shape of the imprint. Cureton demonstrated the low validity of the footprint angle as a measure of the vertical height of the arch and functional efficiency of the foot in a study of 135 college men.[13] He concluded that "the Pedograph as a single method is not a reliable guide for classifying foot cases" although he modified this opinion in the case of Clarke's method.[14] Clarke's technique has advantages in supplying a permanent record in that degrees of flatness can be plotted on a curve and improvement of the feet can be measured. Even with the use of this method, however, some of the signs of flat foot are not recorded and some standard would have to be adopted for classifying the subjects into two categories, normal and flat. The standard adopted would still be arbitrary and subjective and would represent a compromise of the varying opinions of the examining physicians. Thus the validity of the results would continue to depend upon the quality of the judgment of the physicians.

Cureton constructed a test for the functional condition of the feet, combining measurements of the orthopedist and the physical educator.[15] His test consists of a battery of measurements including some of a structural character, *e.g.*, height of scaphoid, and some of a functional or dynamic character, *e.g.*, knee-extension strength. It would be interesting to discover the relationship of weight to the composite scores of his test.

On the whole, considering that the present study was concerned with foot structure, it was felt that, with well trained physicians conducting the examinations, the economy of the method used herein outweighed its faults.

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6 H. R. Danford, "A Comparative Study of Three Methods of Measuring Flat Feet and Weak Feet," *Supplement to Research Quarterly*, 6:2 (May, 1935), pp. 43-49.

7 H. Harrison Clarke, "An Objective Method of Measuring the Height of the Longitudinal Arch in Foot Examinations," *Research Quarterly*, 4:3 (October, 1933), pp. 91-98.

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9 Morton, *op. cit.*, pp. 155-159.

10 Lake, *op. cit.*, pp. 90-101.

11 Frank D. Dickson and Rex L. Diveley. *Functional Disorders of the Foot.* 2nd ed. Philadelphia: J. B. Lippincott Co., 1944, pp. 57-65.

12 Morton, *op. cit.*, pp. 107, 108.

13 T. K. Cureton, Jr., "The Validity of Footprints as a Measure of the Vertical Height of the Arch and Functional Efficiency of the Foot," *Supplement to Research Quarterly*, 6.2 (May, 1935), pp. 72-80.

14 T. K. Cureton, Jr., "Fitness of Feet and Legs," *Supplement to Research Quarterly*, 12:2 (May, 1941), p. 378.

15 *Ibid.*, pp. 368-380.

SUBJECTS

In all, 4,322 subjects were examined. They had a considerable degree of homogeneity of social, economic, and cultural background, with a history of lifetime residence in New York City. The latter point may explain the high incidence of flat foot and conforms to the findings of the World War I draft, in which a higher incidence of flat foot occurred among the urban than among the rural population.[16]

RESULTS

Of the 4,322 subjects, 2,648 were diagnosed as having normal feet and 1,674 as having some degree of flat feet. Table I shows the averages of the age, height, weight, and Ponderal Index of the subjects with normal feet and of the subjects with flat feet; the standard deviations of these items, the standard errors of the means, the differences between the means, the standard errors of these differences, and the measures of reliability of the differences between the means for the two groups.

TABLE I

MEASURES OF WEIGHT, HEIGHT, AGE, AND PONDERAL INDEX OF SUBJECTS WITH NORMAL FEET AND WITH FLAT FEET

Subjects	*Number*	*Mean*	σ	σ *Mean*	D	σ D	$\frac{D}{\sigma D}$
			Weight				
Normal	2648	134.3635	17.6855	.3437			
					4.2265	.5914	7.1466
Flat	1674	138.5900	19.6935	.4813			
			Height				
Normal	2648	66.8965	2.4930	.0484			
					.1068	.0778	1.3728
Flat	1674	66.7897	2.4940	.0610			
			Age				
Normal	2648	17.4864	1.2668	.0246			
					.0145	.0401	0.3616
Flat	1674	17.4719	1.2972	.0317			
			Ponderal Index				
Normal	2648	23.1794	.8916	.0173			
					.2797	.0305	9.1705
Flat	1674	23.4591	1.0275	.0251			

AGE

The average age of all subjects in the study was 17.48 years. The average age of the subjects with normal feet was 17.49 years and of those with flat feet 17.47 years. Those with flat feet were younger by .01 years, but the difference in age is not statistically reliable as can be seen from the D/σD of 0.3616.

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16 A. G. Love and C. B. Davenport. *Defects in Drafted Men.* Washington, D. C.: War Department, 1920, p. 387.

HEIGHT

The average height of all subjects was 66.8551 inches. The average height of the normal group was 66.90 inches and that of the flat-footed group was 66.79 with the normals 0.11 inches taller. The difference in height was extremely slight, representing less than two-tenths of one percent of the total, and substantially unreliable as indicated by the D/σD of only 1.3728.

WEIGHT

When the weight of the two groups is considered a statistically reliable difference in the means appears. The average weight of all the subjects was 136.00 pounds, that of the normal group being 134.36 pounds, and that of the flat-footed group, 138.59 pounds with a substantial difference of 4.23 pounds. The D/σD was 7.1466, considerably more than required for statistical reliability.

PONDERAL INDEX

It has long been recognized that a better picture of body build can be obtained from an expression representing the relationship of several structural characteristics. The Ponderal Index is one such expression, being a unit obtained from the formula:

$$\text{P.I.} = \frac{100\ \sqrt[3]{\text{W (grams)}}}{\text{H (cms.)}}$$

In this unit, height and weight are both taken into account. The data in this study were converted into grams and centimeters for purposes of obtaining the Ponderal Index of each subject. The average P.I. for all subjects was 23.2877, that for the normal group, 23.1794, and for the flat-footed group, 23.4591, the latter group having a higher P.I. by .2797. This indicates a stockier build for the flat-footed subjects. As in the case with weight, the difference in this instance is also statistically reliable with a D/σD of 9.1705.

CORRELATIONS

Table II shows the correlations between height and weight, weight and age, and age and weight for the two groups of subjects.

TABLE II

CORRELATIONS OF THE VARIOUS FACTORS STUDIED

Normal Group			*Flat-Footed Group*		
Factors	*r*	*P.E.r*	*Factors*	*r*	*P.E.r*
Ht.-Wt.	+.575	.0088	Ht.-Wt.	+.490	.0125
Wt.-Age	+.182	.0125	Wt.-Age	+.104	.0163
Ht.-Age	+.106	.0130	Ht.-Age	+.068	.0164

As will be seen in Table II, the most significant relationship among the factors studied in both groups is found in height and weight. The correlations of +.575 and +.490 for the normal group and the flat-footed group respectively show a distinct relationship between height and weight, which does not obtain for weight and age or for height and age within the limits of this study.

PARTIAL CORRELATIONS

Partial correlations of the three factors, weight, height and age, are shown in Table III.

TABLE III

PARTIAL CORRELATIONS

Weight: 1		Height: 2	Age: 3	
Normal			Flat	
r12.3	+.57		r12.3	+.49
r13.2	+.14		r13.2	+.08
r23.1	+.01		r23.1	+.02

Whether age is held constant as in Table III or permitted to vary as in Table II, there is very little difference in the relationship of height and weight. This is readily seen in the correlations for height and weight both for the normal group and the flat group:

	Normal		Flat	
Table II	r(hw)	+.575	r(hw)	+.490
Table III	r12.3	+.57	r12.3	+.49

It will also be noted that the small and relatively insignificant correlation found between height and age (Normal: +.106; Flat: +.068) disappears when weight is held constant and eliminated as a factor influencing the other measurements: Normal r23.1: +.01 and Flat r23.1: +.02. Weight varies slightly with age (Normal r: +.182 and Flat r: +.104) although this relationship decreases when height is held constant: Normal r13.2: +.14 and Flat r13.2: +.08.

Now as to the bearing of these computations on the relationship between weight and the incidence of flat feet, Tables II and III show that the correlations in the normal group are slightly higher than the corresponding ones in the flat-footed group. This may be partially explained by the smaller number of cases and by the greater ranges and deviations as shown in Table I in the flat-footed group. The lower correlation (rhw: +.49) in the flat-footed group shows that these subjects have a somewhat lesser symmetrical build, at least with respect to height and weight. This latter point corroborates the Ponderal Index results. As might have been anticipated, however, these intercorrelations between age, height, and weight do not cast any significant light upon the relationship between body weight and flat feet.

Thus far the only significant findings for this central problem have been that the mean weights and Ponderal Indices of the flat-footed group are greater than those of the normal group.

CORRELATION BETWEEN WEIGHT AND FLAT FEET

A further relationship between weight and flat feet is revealed by a statistical technique which itself merits explanation. Ordinarily a correlation may be obtained between two variables of which there are a sufficient number of intervals and cases at each interval for convenient statistical treatment. This condition is satisfied as far as weights are concerned. In fact, the weights of the subjects are well distributed along the normal curve. But at first glance, there is no curve of flat-footed cases. All the subjects are either flat footed or normal, with no intermediate categories or intervals within the two categories. To overcome this difficulty and to make a correlation analysis possible, an approach not commonly used was adopted. This consisted of calculating the percentages of cases of subjects with flat feet at each interval of weight. Of the four 85-pound subjects, none or 0.00 percent was found to have flat feet. Of the fourteen 90-pound subjects, four or 28.57 percent had flat feet. Table IV shows the percentages of flat-footed subjects at each weight interval. These percentages may then be arranged in rank order and correlated with the rank order of the weight intervals by the method of rank-difference correlation, as shown in Table IV.

TABLE IV

PERCENTAGES OF FLAT-FOOTED SUBJECTS AT EACH WEIGHT INTERVAL

Lbs.	*Total Cases*	*No. of Flats*	*% of Flats*	*Rank Order of Flats*	*Rank Order of Weight*	*d*	d^2
95	4	0	0.00	1	1	0	0
90	14	4	28.57	2	2	0	0
95	33	11	33.33	6	3	3	9
100	64	20	31.25	3	4	1	1
105	129	44	34.11	7	5	2	4
110	231	76	32.90	5	6	1	1
115	294	105	35.71	8	7	1	1
120	457	147	32.17	4	8	4	16
125	508	183	36.02	9	9	0	0
130	517	189	36.56	10	10	0	0
135	510	198	38.82	11	11	0	0
140	397	169	42.57	15	12	3	9
145	304	125	41.12	14	13	1	1
150	256	114	44.53	16	14	2	4
155	172	69	40.12	13	15	2	4
160	122	57	46.72	17	16	1	1
165	94	49	52.13	20	17	3	9
170	53	21	39.62	12	18	6	36
175	49	25	51.02	18	19	1	1
180	38	21	55.26	21	20	1	1

185	29	15	51.72	19	21	2	4
190	19	12	63.16	23	22	1	1
195	16	9	56.25	22	23	1	1
200	8	7	87.50	24	24	0	0
205	4	4	100.00	25	25	0	0
	4322	1674					104

$$P = 1 - \frac{6\Sigma d^2}{n(n^2-1)} = 1 - \frac{624}{25(625-1)} = .96$$

r: + .9635 P.E.: .0119

TABLE V

PONDERAL INDEX RANK-DIFFERENCE CORRELATION

P.I.	*Total Cases*	*No. of Flats*	*% Flats*	*Rank Order Flats*	*Rank Order P.I.*	*d*	d^2
20.0	1	0	0.00	1	1	0	0
20.5	11	5	45.45	8	2	6	36
21.0	51	15	29.41	2	3	1	1
21.5	218	66	30.28	3	4	1	1
22.0	521	166	31.86	4	5	1	1
22.5	980	328	33.47	5	6	1	1
23.0	963	382	39.56	7	7	0	0
23.5	711	269	37.83	6	8	2	4
24.0	426	202	47.42	9	9	0	0
24.5	245	124	50.61	12	10	2	4
25.0	85	42	49.41	10	11	1	1
25.5	58	40	68.97	15	12	3	9
26.0	33	22	66.67	13½	13	½	¼
26.5	15	10	66.67	13½	14	½	¼
27.0	2	1	50.00	11	15	4	16
27.5	2	2	100.00	16	16	0	0
	4322	1674					74.5

$$P = 1 - \frac{6\Sigma d^2}{n(n^2-1)} = 1 - \frac{447}{16(256-1)} = 1 - .1096 = .8904$$

r: + .899 P.E.: .0365

TABLE VI

RANK-DIFFERENCE CORRELATIONS

	r	*P.E.*	*No. of Ranks*
Weight and flat feet	+.9635	.0119	25
Age and flat feet	—.271	.1636	16
Height and flat feet	—.227	.1803	16
Ponderal Index and flat feet	+.899	.0365	16

Table V contains the rank-difference correlation for Ponderal Indices.

The procedure outlined above was also applied to height and age. The percentages of flat-footed subjects at each height interval

and at each age interval were obtained. In each case rank-difference Correlations were worked out. Table VI contains a summary of all these calculations.

It is immediately apparent from Table VI that of the four measures, two are reliable and significant. The correlations for weight and Ponderal Index with flat footedness are positive and of a very high order, +.9635 and +.899 respectively, whereas, those for age and height with flat footedness are so low and variable (P.E.'s of .1636 and .1803) as to show little relationship to the incidence of flat feet.

These high rank-difference correlations (+.9635 and +.899) should not be taken at face value. They are spuriously high because reversions within each step interval which would lower a correlation obtained by the product-moment method are masked by taking the step interval as a whole and correlating it with the percentage of flat feet in the interval. Also the rank methods indicate the presence of relationship rather than the extent of relation.[17] Nevertheless, for comparative purposes, they have some validity, showing the absence of association of the factors of age and height with flat feet and the greater correspondence between gross weight and Ponderal Index with flat feet.

BISERIAL CORRELATIONS

The method of biserial correlation was applied to the data in the following way. The weight intervals, *i.e.*, 85, 90, 95, etc., were used as the continuous variable and the dichotomous variable contained those with flat feet in Column I and those with normal feet in Column 2. The correlations found were extremely low but carried out the pattern previously observed in the rank-difference correlations:

r_{bis} (age and feet)	.01
r_{bis} (height and feet)	.02
r_{bis} (weight and feet)	.14
r_{bis} (P.I. and feet)	.17

However, the biserial method does not apply accurately to the data in this study. It can be applied mechanically but is more appropriate under other conditions. For example, it is useful in determining how well the answer to a particular test item can distinguish between those who score high on the total test and those who score low.

The coefficient obtained by the biserial method depends largely upon the number of cases at each interval. This can be seen from examination of the formula:

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17 Henry E. Garrett. *Statistics in Psychology and Education.* New York: Longmans, Green and Co., 1926, p. 195.

$$r_{bis} = \frac{M_p - M_q}{\sigma} \times \frac{pq}{z}, \text{ where}$$

M_p represents the mean of the distribution of weights of the flat group, M_q is the mean of the distribution of the normal group, σ is the standard deviation of the combined distributions, p is the percentage of the flat-footed subjects in the study, q the percentage of normal subjects and z is the height of the ordinate separating the percentage of flats from the percentage of normals in the normal frequency distribution. Since $\frac{pq}{z}$ is a product which remains constant for all four coefficients and affects them equally, it may be disregarded in this analysis.

We have left the first part of the formula:

$$\frac{M_p - M_q}{\sigma}$$

The coefficient, then, is largely determined by the size of the means. Since these in turn are influenced mostly by the central intervals where the bulk of the cases is concentrated, the extremes lose significance, particularly the upper extremes where the highest percentage of flat feet is found.

In the present study, our concern is not with the number of individuals in any interval of weight, but rather with the incidence of flat feet at these levels. But, because there were few subjects who weighed 200 pounds and many who weighed 130 pounds, the biserial coefficient is diminished and fails to show adequately the relationship between weight and the incidence of flat feet.

To make possible an examination of the existence or nonexistence of this relationship, it is necessary to equalize the number of individuals at each weight interval, thus eliminating any influence exercised by unequal numbers of subjects at each interval. This could be done by selecting equal numbers of subjects at each weight interval, obviously impossible under the conditions of this study, or by using the percentages of flat feet at each weight interval. The rank-difference method utilizes this latter principle and is the more appropriate technique in this study.

MEAN WEIGHTS AT EACH HEIGHT INTERVAL

Table VII contains an analysis of the weights of the two groups at each step interval of height. The mean weight of the individuals at each height interval is shown as well as the differences in the means. It will be seen that in nearly all cases the flat-footed subjects are heavier on the average than the normal subjects of the same height.

TABLE VII

EXCESS OF WEIGHT OF FLAT-FOOTED GROUPS OVER NORMAL GROUPS AT EACH STEP INTERVAL OF HEIGHT

	Normal		*Flat*		*Excess of*
Height	*Mean Weight*	*σ*	*Mean Weight*	*σ*	*Flat Group*
(*inches*)	(*lbs.*)	(*lbs.*)	(*lbs.*)	(*lbs.*)	(*lbs.*)
59	109.28	15.35	98.75	5.45	−10.53
60	108.13	13.74	118.77	13.77	10.64
61	115.80	15.59	129.32	16.62	13.52
62	118.03	14.37	120.55	16.91	2.52
63	120.82	14.29	124.96	15.45	4.14
64	124.67	13.05	130.15	17.08	5.48
65	128.11	13.13	132.74	16.58	4.63
66	131.53	13.93	137.48	16.74	5.95
67	137.65	13.88	143.03	16.60	5.38
68	139.05	14.08	144.64	16.99	5.59
69	145.47	16.24	147.97	17.68	2.50
70	151.38	15.51	155.28	18.15	3.90
71	160.91	15.55	155.80	17.44	−5.10
72	157.88	16.72	163.21	17.20	5.33
73	152.42	11.08	161.50	20.10	9.08
74	180.00	6.29	140.00	0.00	−40.00

ANALYSIS OF FLAT-FOOT INCIDENCE IN RELATION TO BUILD

Finally, with reference to Table V, among the 802 subjects with lighter builds (P.I.'s 20.0 to 22.0), 252 or 31 percent are flat footed and among the so-called normal builds (P.I.'s 22.5, 23.0, and 23.5, the three most numerous intervals) 979 or 37 percent are flat footed. But among the 866 heavier builds 443 or 51 percent are flat footed.

CONCLUSIONS

The evidence indicates a positive relationship between body weight and flat feet, particularly for the upper extreme in weight. Among 4,322 college men examined, of whom 2,648 had structurally normal feet and 1,674 had flat feet in some degree as diagnosed by trained physicians, the flat-footed group was on the average 4.2 pounds heavier. The difference was statistically completely reliable. Also the flat-footed group had a higher Ponderal Index. The two groups were not different on the average with respect to two other values, height and age.

Not only was the flat-footed group heavier than the normal group, but the evidence indicates that flat feet vary directly with weight, the greater the weight the greater the percentage of flat-footed subjects. Expressed in terms of probability of occurrence, the heavier the person the greater his chances of having flat feet. This conclusion holds for Ponderal Index in almost equal degree, the higher the P.I., the greater the chance of the occurrence of flat feet.

Aside from the Ponderal Index calculations which showed a stockier build in the flat-footed group, this study did not attempt to determine directly the incidence of flat feet among the overweight, the normal weight, and the underweight. These conditions are difficult to establish. Quimby showed that height is only one and not the most important factor in determining how much a man should weigh and that a short, heavy person need not be overweight if other structural characteristics, shoulder width, chest depth, hip width, etc., are taken into account.[18] In fact, Quimby found that height has a predictive value (r^2hw) for weight of only .2227. Incidentally, the present study found higher predictive values, namely, for all subjects, .2938; for normal group, .3306; and for flat-footed group, .2401.

To the extent that the Ponderal Index can be said to indicate underweight and overweight, however, a very interesting result appeared in this study.

This finding is the fact that both gross weight and the Ponderal Index correlated about equally with flat feet, and that so many so-called normal builds were accompanied by flat feet, and that so many so-called overweight builds were accompanied by normal feet. It is commonly believed that overweight people have flat feet. This was found in the results which indicated that flat-footed subjects were heavier on the average than normal subjects of the same height, and in the analysis of flat foot incidence in relation to build. It would seem that in the incidence of flat feet, however, how much the subject weighs may be as important as how his body is built in terms of the Ponderal Index.

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18 R. C. Quimby, "What a Man Should Weigh," *Research Quarterly*, 5:1 (March, 1934), p. 106.

Evaluative Criteria in Physical Education

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INTRODUCTION AND SCOPE OF THE PROBLEM

TEACHER training in health and physical education has progressed rapidly and accomplished much since its beginning in the United States, nearly eighty-four years ago. Problem after problem has arisen, but probably none is so important as that of determining what should be included in the preparation of the prospective teacher of physical education. What are some of the courses necessary in the field of the foundation sciences, such as biology, chemistry, physics, human anatomy and physiology, sociology, hygiene, etc.? What courses in the field of general education, such as introduction to education, history of education, educational psychology, educational sociology, educational statistics, etc., should be included? What courses in the technical field of health and physical education are necessary for the better preparation of teachers of physical education?

Answers to these questions regarding the curriculum, together with many closely related problems, are basic to the better understanding of teacher education in health and physical education. The present problem is concerned with these questions and answers, with particular emphasis being placed upon the educational preparation of prospective men teachers of health and physical education for the secondary schools.

Dr. Hetherington, one of the early leaders in the field of teacher education in health and physical education, points to the fact that all of the problems of education may be classified under eight general groups, or nine when the profession is included. They are:

1. Interpretation.
2. Objectives.
3. Social and Institutional Organizations and Auspices.
4. Educability, Classification, and Testing of People.
5. Program (Educative and Protective).
6. Leadership or Teaching Methods.
7. Administration.
8. History.
9. The profession.[1]

This paper is an abstract of a dissertation accepted by the Graduate School of Education at Yale University for the degree of Doctor of Philosophy, 1945.

He further states that the study and acquisition of knowledge about the problem content in these education sciences, with reference to health and physical education, depend upon a thorough knowledge of the foundation sciences of biology, chemistry, physics, anatomy, physiology, psychology, sociology, hygiene, and bacteriology.[2]

The National Study Committee on Professional Education in Health and Physical Education recommends a four-group classification in the arrangement of the curriculum for teacher education in physical education.[3] These four groups are (1) academic courses required by the institution (other than the foundation sciences), (2) foundation sciences (including academic requirements in science), (3) required courses in professional education, and (4) courses required in health and physical education.

The fourth of these general divisions, courses in health and physical education, is further subdivided into the general problems indicated by Dr. Hetherington,[4] with two exceptions. First, interpretation and objectives, instead of being two separate problems, are combined to form Problem I. Secondly, the problem of social and institutional organization and auspices is omitted, as it would be difficult to group courses under this heading. This leaves seven specific divisions, with an eighth, of a general nature, added to include miscellaneous courses and individual study.

On the basis of this pioneer work by Dr. Hetherington, and the later revisions of the general course groupings by the National Study Committee, the present study, which is concerned with course standards upon which preparation of teachers in health and physical education may be based, has been made.

In attempting such a study, it was deemed necessary to follow three definite steps. In the first place, an analysis of the teacher certification requirements for each of the forty-eight states was made. These requirements were divided into those concerning (1) the general academic field, (2) the foundation sciences, (3) professional education, and (4) the technical field of health and physical education. This was done by means of a questionnaire sent to each of the states, asking for specific requirements in these fields. A one hundred-percent return of this questionnaire was received.[5]

Secondly, seventy-five schools offering major programs in teacher education in physical education were selected, their catalogues from 1935-40 were closely scrutinized, and the requirements of each in the above fields were analyzed. Selection of these schools

1 C. W. Hetherington, "Professional Education in Physical Education," *Journal of Health and Physical Education*, 5:9 (November, 1934), p. 3.

2 *Ibid.*, p. 4.

3 National Committee Report on Standards, "National Study of Professional Education in Health and Physical Education," *Research Quarterly*, 6:4 (December, 1935), pp. 48-68.

4 *Ibid.*, p. 57.

5 A complete summary of these state requirements will be published later.

was made on the basis of three factors, i.e., a geographical distribution that would cover the majority of the states, a selection only of the schools that appeared on the approved list published in 1944 by the American Association for Health, Physical Education, and Recreation, and a selection only of the schools that appeared on the filled-in questionnaire of each state.

The third step followed was to get the opinion of experts in the field of health and physical education as to basic courses in the above-mentioned areas of study for teacher education in health and physical education. Nine men, known to be leaders in this field, were asked to send in a list of other leaders. These lists were divided at random into groups A and B. Group A was composed of the lists of five men, and group B, those of four men. In the final selection, only those leaders were chosen whose names were submitted by at least one member of each of these groups. This afforded a list of thirty-five experts in the field to whom the questionnaire, which was based upon the data gathered from the study of the seventy-five school programs and an analysis of teacher certification in the forty-eight states, was sent.

RECOMMENDATION OF CRITERIA FOR COURSE STANDARDS

On the basis of these three groups of data, together with some of the recommendations of later literature regarding trends in general education, it seems reasonable to suggest some basic factors upon which programs or curricula designed for the purpose of preparing men teachers of health and physical education in the secondary schools may be based. These factors, stated as criteria, may be enumerated as follows:

1. *First Criterion (Degrees).*—The prospective teacher of health and physical education should have a minimum of four years of preparation on the college level, and should be the recipient of a bachelor's degree.

2. *Second Criterion (Semester Hours).*—A minimum of 120 semester hours of study should be required for the bachelor's degree.

3. *Third Criterion (Curriculum Percentages).*—The percentage of the total curriculum in the general academic area should range from 21 percent to 25 percent.

4. *Fourth Criterion (Curriculum Percentages).*—The percentage of the total curriculum to be allotted to the area of the foundation sciences (natural or basic sciences) should range from 18 percent to 22 percent.

5. *Fifth Criterion (Curriculum Percentages).*—The percentage of the total curriculum to be allotted to the area of professional education should range from 15 percent to 17 percent.

6. *Sixth Criterion (Curriculum Percentages).*—The percentage of the total curriculum to be allotted to the area of health and physical education should range from 33 percent to 40 percent.

7. *Seventh Criterion (Specific Courses).*—The general academic area should include courses in the area of the humanities, i.e., English composition, English literature, modern languages, philosophy, etc., and courses in the social sciences.

8. *Eighth Criterion (Specific Courses).*—The area of the foundation sciences (natural or basic sciences) should include courses in human physiology, human anatomy, general psychology, and general chemistry, biology, or zoology.

9. *Ninth Criterion (Specific Courses).*—The area of professional education should include student teaching, educational psychology, methodology, and courses giving the individual a better understanding of the history of education.

10. *Tenth Criterion (Specific Courses).*—The area of health and physical education should include specific courses in problems I, II, III, IV, and V.[6]

The first criterion, in relation to the requirement of degrees, seems to be a quite uniform procedure. It does not appear to make much difference as to what the terminology of the degree is, as is indicated in Table I. The important thing to note in this table, however, is that all of the schools studied, with the exception of two whose degree status could not be determined, and all of the experts who participated in the study, recommended at least a bachelor's degree. Only five of the forty-eight states did not require a degree for certification to teach within those states, but one of these five (Oklahoma) required the degree for permanent certification.

TABLE I

TYPES OF BACHELOR DEGREES OFFERED FOR GRADUATION WITH A MAJOR IN HEALTH AND PHYSICAL EDUCATION

Name of Degree	*Required in 73 Selected Schools*	*Recommendations of 31 Experts*
1. Bachelor of Arts (A.B.)	13	4
2. Bachelor of Science (B.S.)	16	2
3. Bachelor of Science in Physical Education (B.S. in P.E.)	19	12
4. Bachelor of Science in Education (B.S. in Ed.)	15	8
5. A.B. or B.S.	4	1
6. Bachelor of Education (B. Ed.)	2	....
7. Bachelor of Education in Physical Education (B. Ed. in P.E.)	1	....

[6] Problem I—Interpretation and Objectives, Problem II—Classification and Testing, Problem III—The Program, Problem IV—Leadership, and Problem V—Administration.

8.	Bachelor of Arts in Education (A.B. in Ed.)	2	....
9.	B.S. or Bachelor of Physical Education (B.S. or B.P.E.)	1	....
10.	Immaterial	....	4*
	Total	73 schools	31 experts

*Many others stated that it was immaterial, but checked the degree that they preferred.

The second criterion, in relation to the semester hour requirements, recommends a minimum of 120 semester hours of credit in order to qualify for a bachelor's degree. It is recognized that many educators may not feel that a specific number of semester hours is of much concern, but the majority of institutions use the semester hour as a basis of credit, so it seems feasible to utilize that means of credit until a more suitable basis may be determined. It is assumed, of course, that a semester hour of credit is to be defined as the credit awarded for one hour of work and study per week for at least sixteen weeks. Table II shows the semester hours of credit required for graduation by the selected schools used in this study.

Criteria 3, 4, 5, and 6, in relation to the percentages of the total curriculum to be allotted to each of the four areas used throughout this study, may be open to criticism. Education is individual, and hence each individual may vary as to the benefits that he will receive from any specific area of concentration. Criterion 3 recommends that from 21 percent to 25 percent of the total curriculum should be in the general academic field, but surely if it is felt that the individual will benefit from more concentration in this area, such arrangements should be made. The same may be said of criterion 4, which recommends from 18 percent to 22 percent in the foundation sciences; of criterion 5, which recommends from 15 percent to 17 percent in the area of professional education; and of criterion 6, which recommends from 33 percent to 40 percent in the area of health and physical education.

TABLE II

TOTAL SEMESTER HOUR REQUIREMENTS FOR GRADUATION IN SEVENTY-FOUR SELECTED SCHOOLS

Range of Semester Hour Requirements	*Frequency of Semester Hour Requirements*
162 - 164	1
159 - 161	—
156 - 158	—
153 - 155	—
150 - 152	—
147 - 149	—
144 - 146	3
141 - 143	2

138 - 140	2
135 - 137	2
132 - 134	2
129 - 131	1
126 - 128	17
123 - 125	25
120 - 122	18
117 - 119	1
Total (N)	74
Average (Mean)	127 semester hours
Median	121.7 " "
Mode	124 " "

Table III shows the percentage distributions of the selected schools as compared with the distribution of the percentages recommended by the thirty-one experts, as to each of the areas mentioned.

Criterion 7 is in relation to the specific courses in the general academic area. Table IV shows a detailed comparison of certain specific courses in this area between curricula of seventy-five selected schools and recommendations of thirty experts. It may be seen from this table that a course in English composition and courses in the social sciences are practically unanimous recommendations on the part of both groups. English literature and speech fundamentals are required by the majority of the schools, as well as being recommended by most of the experts. Other courses in that area varied a great deal with respect to both groups, but those most frequently mentioned were courses in the modern languages, mathematics,

TABLE III

PERCENTAGES OF THE TOTAL CURRICULUM IN AREA I—GENERAL ACADEMIC, AREA II—FOUNDATION SCIENCES, AREA III—PROFESSIONAL EDUCATION, AREA IV—HEALTH AND PHYSICAL EDUCATION

Percentage Range	*Area I*		*Area II*		*Area III*		*Area IV*	
	72 *Sch.*	31 *Exp.*	72 *Sch.*	31 *Exp.*	73 *Sch.*	31 *Exp.*	73 *Sch.*	31 *Exp.*
52 - 55	—	—	—	—	—	—	2	—
48 - 51	—	1	—	—	—	—	2	5
44 - 47	—	1	—	—	—	—	5	2
40 - 43	—	1	—	—	—	—	13	10
36 - 39	—	—	—	—	—	—	11	2
32 - 35	6	5	—	1	—	—	18	4
28 - 31	5	3	2	3	1	—	7	3
24 - 27	13	5	4	9	2	2	7	5
20 - 23	17	6	15	12	21	5	5	—
16 - 19	14	4	30	3	31	8	3	—
12 - 15	9	4	15	2	12	4	—	—
8 - 11	7	1	6	1	6	12	—	—
4 - 7	1	—	—	—	—	—	—	—
Average	20.7%	25.4%	17.4%	21.3%	16.5%	14.2%	33.7%	38.0%
Median	20.9%	23.9%	17.3%	21.4%	16.9%	14.0%	32.9%	40.0%
Mode	21.5%	21.5%	17.5%	21.5%	17.5%	9.5%	33.5%	41.5%

music appreciation, art appreciation, dramatics, religion, crafts, and ethics.

The recent report of the Harvard Committees states that,

Tradition points to a separation of learning into the three areas of natural science, social studies, and the humanities.[7]

TABLE IV

SPECIFIC COURSES IN THE GENERAL ACADEMIC AREA

Courses	*No. of Schools Requiring Course*	*Average No. of Semester Hours*	*Recommendations of 30 Leaders in the Teacher Education Field*	
			Number	*Av. Sem. Hrs.*
English Composition	71	5.5	30	5.6
Social Sciences	65	9.5	30	8.2
English Literature	48	5.4	25	4.5
Speech Fundamentals	39	3.5	29	3.6
Modern Languages	31	10.3	8	7.1
Mathematics	24	4.6	14	4.6
Humanities	6	6.7	18	6.0
Free Electives in all Four Areas	50	22.3	*	*

Other courses in this area that were mentioned were: Music Appreciation, Art Appreciation, Religion, Dramatics, Crafts, Ethics.

* Electives were included in each of the four general areas.

TABLE V

SPECIFIC COURSES IN THE AREA OF THE FOUNDATION SCIENCES

Courses	*No. of Schools Requiring Course*	*Average No. of Semester Hours*	*Recommendations of 30 Leaders in the Teacher Education Field*	
			Number	*Av. Sem. Hrs.*
Human Physiology	71	4.4	30	5.0
Human Anatomy	65	3.5	30	3.9
General Psychology	59	3.2	27	3.6
General Chemistry	48	6.3	27	5.0
Personal Hygiene	46	3.0	29	2.8
General Biology	31	5.7	23	4.9
General Sociology	31	3.4	22	3.1
General Zoology	29	4.9	14	4.6
General Physics	8	4.9	14	3.9

Other courses in this area that were mentioned were: Bacteriology and Genetics.

Omitting the natural sciences, which, to follow the organization used in the present study, are grouped into the specific area of the foundation sciences, a study of the social studies is intended:

To produce an understanding of our social environment and of human institutions in general, so that the student may achieve a proper relation to society—not only the local but the great society, and by aid of history, the

[7] Report of the Harvard Committee. *General Education in a Free Society.* Cambridge, Massachusetts: Harvard University Press, 1945, p. 58.

society of the past and even the future. Finally, the purpose of the humanities is to enable man to understand man in relation to himself, that is to say, in his inner aspirations and ideals.[8]

Criterion 8 is in relation to specific courses in the area of the foundation sciences. These sciences are fundamental to an adequate preparation of future teachers in the field of health and physical education, as a basic understanding of certain principles related to these sciences is essential to later applied work in teaching in this area. Table V indicates the specific courses in this area as required by the selected schools, and compares these requirements with the recommendations of the thirty experts. Human physiology, human anatomy, general psychology, and general chemistry seem to be the most common with respect to each of the groups. Twenty-three of the experts recommended a course in general biology and fourteen of them, a course in general zoology. These, however, were not required by very many of the selected schools.

Specific courses in this area, as is true in the other areas, must have both general as well as more specialized education as objectives. They must be general in that they will afford the individual a better understanding of the physical environment, but they must also be specialized to the extent that they will afford the individual a knowledge of the fundamental principles basic to the teaching of health and physical education.

Criterion 9, in relation to specific courses in the area of pro-

TABLE VI

SPECIFIC COURSES IN THE AREA OF PROFFESSIONAL EDUCATION

Courses	*No. of Schools Requiring Course*	*Average No. of Semester Hours*	*Recommendations of 30 Leaders in the Teacher Education Field*	
			Number	*Av. Sem. Hrs.*
Student Teaching	68	5.5	30	6.1
Educational Psychology	63	3.5	30	3.0
Prin. of Secondary Educ.	50	3.2	20	2.6
Educational Methodology	37	3.3	14	2.6
Tests and Measurements in Education	36	2.6	9	3.8
Introduction to Education	34	2.8	16	2.3
History of Education	31	3.0	18	2.6
Educational Administration	23	2.8	10	2.5
Principles of Teaching	20	2.9	14	2.4
High School Education	16	3.4	2	2.5
Educational Sociology	15	2.8	11	3.1
Principles of Education	13	3.3	12	2.7
State School Organization	9	2.3	4	1.8
Observation*				

* Observation was mentioned by many leaders as a specific prerequisite for student (practice) teaching.

[8] *Ibid.*, p. 59.

fessional education, must be designed, not only to afford the individual better methods of presenting material to others, and an opportunity to practice in the field, but they must help him to grasp a better understanding of the role of education in society.

TABLE VII

SPECIFIC COURSES IN THE AREA OF HEALTH AND PHYSICAL EDUCATION

Courses	*No. of Schools Requiring Course*	*Average No. of Semester Hours*	*Recommendations of 30 Leaders in the Teacher Education Field*	
			Number	*Av. Sem. Hrs.*
Problem I—Interpretation and Objectives				
Principles of Phys. Educ.	44	2.8	26	2.8
Introduction to Phys. Educ.	19	2.2	15	1.9
Nature & Function of Play	14	2.3	15	2.3
Interpretation and Objectives	2	2.3	3	3.7
Problem II—Educability, Classification and Testing				
Tests & Measurements in Physical Education	39	2.4	28	2.9
Physical Examinations and Anthropometry	20	2.6	14	2.4
Normal Growth and Development	3	2.0	13	2.5
Problem III—The Program				
Individual Program Adaptations (Correctives)	54	2.6	27	2.7
Health Education (not broken down into specific courses)	52	4.7	30	5.2
Kinesiology	44	2.6	27	2.6
Physiology of Exercise	29	2.3	24	2.6
School Programs in Phys. Educ.	14	3.0	15	2.6
Problem IV—Leadership				
Student Teaching	68	5.5	30	6.1
Training & First Aid	55	2.0	26	2.1
Methods of Phys. Educ.	49	4.0	22	3.5
Recreational Leadership	51	3.0	20	2.9
Camping	12	2.0	18	2.0
Theory of Coaching*	65	7.9	19	4.1
Phys. Educ. Activities*	54	4.7	19	8.7
Skills & Techniques*	21	5.2	9	7.2
Major Sports*	6	3.3	9	5.2
Rhythms	24	2.3	12	2.2
Safety Education	12	2.1	16	2.0

* These terms are interchangeable in the majority of the programs studied, and in the recommendations of the leaders. It was found that all of the schools studied required work in at least one of these four, and the same may be said of the recommendations of all of the experts.

Scouting	16	1.6	10	1.1
Calisthenics & Gymnastics	27	3.2	10	3.5
Games of Low Organization	13	2.4	12	1.8
Physical Therapy	5	2.9	5	2.2
Problem V—Administration**				
Administration of Phys. Educ.	64	2.7	27	2.9
Administration of Recreation	15	2.7	12	2.2
Administration of Athletics	8	2.1	8	2.5
Administration of Health Programs	6	2.6	12	2.1
Administration of Intramurals	5	2.2	7	2.4
Problem VI—History				
History of Phys. Educ.***	25	2.3	11	2.0
Problem VII—The Profession				
Prof. Educ. in Phys. Educ.	5	2.4	(Most experts recommended this area for graduate work)	
Problem VIII—General & Individual				
Problems in Phys. Educ.	16	2.8	"	"
Indiv. Study & Research	2	4.0	"	"

**Many of the experts recommended that all courses in administration of physical education be included under one title.

*** This course is usually included with the course in principles of physical education.

Table VI shows some of the specific courses in this area that are required by the selected schools, as compared to those recommended by the thirty leaders. It may be noted that student (practice) teaching and educational psychology are recommended unanimously by the experts. They are also required by most of the schools. Requirements and opinions on other courses in this area vary a great deal, but some of the most frequently mentioned by both groups are principles of secondary education, history of education, introduction to education, and educational methodology.

Criterion 10 is in relation to specific courses in the area of health and physical education. This general area of study raises many difficulties with respect to the organization of certain definite courses into various divisions or areas within the larger general areas of health and physical education. Assuming that a specific division such as has been used in this study is recognized, it would appear that certain definite courses bear recognition.

Table VII shows the comparison between the seventy-five selected schools and thirty leaders in the field of specific courses in this area. This table indicates courses under the eight specific problems considered in the area of health and physical education. From data that may be observed in this table, it seems reasonable to state

that under the problem of Interpretation and Objectives courses in the principles of physical education, introduction to physical education, and nature and function of play should be required.

The area of Testing might well be represented by courses in tests and measurements in physical education, physical examinations and anthropometry, and normal growth and development.

Courses in health education should occupy a large portion under the area of Program, and courses in individual program adaptations (correctives), kinesiology, and physiology of exercise may be considered as extremely important.

The area of Leadership, though very hard to define, may well include student teaching, and courses in training and first aid, methods of physical education, recreational leadership, and physical education activities. The latter course may be thought of as including theory of coaching, skills and techniques, and major sports. Other courses such as camping, scouting, rhythms, and safety education should be a definite part of the curriculum under Leadership.

The area of Administration would appear to be well taken care of by a general course in administration of physical education, provided, of course, that such a course would include a discussion of the administration of recreation, athletics, health programs, and intramurals.

The history of physical education seemingly could be included as a part of the course in principles of physical education, while the areas of the Profession and Individual Study and Research should be considered in the graduate curricula rather than the undergraduate.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

This study is based upon certain pioneer work by Dr. Hetherington, and later revisions of certain course groupings by the National Study Committee. The general area organization, as recommended in these earlier studies, was used as the foundation for the establishing of certain criteria with respect to course standards in teacher education in physical education.

Three sources of data were used in establishing these criteria:

1. A detailed analysis of the prewar certification requirements of each of the forty-eight states.

2. A careful study of the prewar curricula for the preparation of teachers of health and physical education in seventy-five selected schools.

3. The opinions of thirty-one (thirty in the case of specific courses) carefully selected leaders in the field of teacher education in health and physical education as to certain recommendations with respect to the curriculum for the preparation of prospective teachers

in that field.

Analysis and comparison of these data formed the basis for the recommendation of certain criteria, with respect to course standards, upon which curricula for the preparation of prospective teachers in health and physical education for men in the secondary schools might be based.

Certain conclusions and recommendations may be drawn from these criteria as follows:

1. Every prospective teacher in health and physical education for men in the secondary schools should have at least four years of study and preparation on the college level, and should be the recipient of a bachelor's degree with a major in physical education.

2. It seems reasonable to require that every prospective teacher in health and physical education for men in the secondary schools should have the equivalent of 120 to 130 semester hours of study during the four-year program.

3. The percentage of the total curriculum that should be allotted to each of the general areas should be: I—Academic, 21 percent to 25 percent; II—Foundation Sciences, 18 percent to 22 percent; III—Professional Education, 15 percent to 17 percent; and IV—Health and Physical Education, 33 percent to 40 percent.

4. It would seem well, as a part of the general academic area, to include courses in English composition and in the social sciences. Other specific courses in the area deemed important in this study, are English literature, speech fundamentals, modern languages, mathematics, the humanities, music appreciation, art appreciation, and dramatics.

5. It seems advisable, as a part of the area of the foundation sciences, to include courses in human physiology, human anatomy, and general psychology. Other specific courses in this area deemed important are general chemistry, general biology, and general zoology.

6. It would seem well, as a part of the area of professional education, to include actual practice in teaching (student teaching) and a course in educational psychology. Other specific courses in the area, deemed important in this study, are principles of secondary education, history of education, introduction to education, and educational methodology.

7. It appears to be advisable, in the area of health and physical education, to further subdivide the area into more specific units or problems. Using the division as recommended by the National Study Committee, it would seem well to include courses in the principles of physical education, introduction to physical educaton, and the nature and function of play under Interpretation and Objectives. Under the Classification and Testing of people, it would be well to include

tests and measurements in physical education, physical examinations, and normal growth and development. The Program area should include courses in health education, individual program adaptations (correctives), kinesiology, physiology of exercise, and school programs in physical education. Leadership, although an area in which there appears to be much difference of opinion as to what courses should be included, might well require student teaching (mentioned before); various activity, coaching, and skills technique courses; recreational leadership, camping, and scouting; training and first aid; methods in physical education; rhythms, calisthenics and gymnastics; and games of low organization. A course in administration of physical education would seem to fulfill the necessary work in the area of Administration, while the history of physical education, representing the problem of History, might well be included along with a course in general principles. Courses pertaining to the areas of the Profession and to Individual Study and Research could well be left for study in the graduate curriculum.

It must be recognized, however, that programs may receive a true evaluation only if the specific content is carefully analyzed, but it seems reasonable to believe that curricula based upon the recommended criteria formulate a basic skeleton of a program that will prove more adequate in the education of prospective teachers of health and physical education.

Petren on The Effect of Growth and Training on the Capillarisation of the Central Nervous System

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(Submitted for publication November, 1945)

IN 1938 and 1939 Dr. Ture Petren of the Anatomy Department of the Karolinska Institute in Stockholm, Sweden, published three papers in which he reported on the result of a study of the capillarisation of the brain in relation to development and intensity of motor activities of guinea pigs.

In his first investigation he used 155 animals of which 32 were fetuses, weighing between 23 and 66 gm., and 47 to 61 fetal days of age. Of the 123 born animals, 45 were male and 78 female. Their ages varied between 1 and 907 days. In order to make the capillaries in brain sections visible, Petren stained the red blood corpuscles in situ, using the orthotolodin—H_2O_2 method of Sjostrand. This procedure produces a dark brown coloration and capillary vessels can thus be located under the microscope. The animals were killed through intra-cardial injection of between .5 and 1 ccm. of histamine. Histamine is a strong vasodilator and Petren is satisfied that with this method virtually all capillaries are opened at the time of death.

The brains were fixed for a period of 24 hours in a 10 percent formalin solution. Corresponding portions of the motor cortex were removed from every brain and frozen sections, 30 micra thick, cut in a frontal plane. After staining, the histological sections were projected upon a white paper screen (enlargement 1 x 1400). Capillary contours within a square which was marked by a calibrated ocular, were now recorded on the paper screen. The length of the sides of each projected square corresponded to 300 micra. The volume of the tissue slide therefore was 300 x 300 x 30 micra (30 being the thickness of the section)=.0027 cubic mm. For every specimen 15 such squares were analyzed. Only blood vessels with diameters of 5 micra and less were considered capillaries. Each capillary as marked on the paper screen was now measured with the help of a

Ed. Note: This paper is not a description of research conducted by the author but a review of literature. Although reviews of literature are not usually included in the Quarterly as articles, it was decided that this paper should be published since it represents a review of rather important research.

recording wheel and the total capillary length established for each calibrated square.

Petren stresses that this method does not yield an absolute measure of the capillarisation of tissue. His data, however, form a reliable basis for comparative quantitative studies.

Capillary density in the motor cortex was lowest in the fetuses and highest in the adult animals. The increase in capillarisation with age, however, is not correlated with the increase in the total body weight of the animals. Capillary growth is most rapid at the end of the fetal period and within the first week after birth. Mean total capillary length just before birth was 915 micra; on the 5th day after birth it was 1270, and on the 170th day after birth, 1490 micra. Already on the 35th day the capillary net had reached its final density. No differences were found between capillarisation of the motor cortex of male and female guinea pigs as shown in Fig. 1.

Petren compared his findings with those reported by Craigie who had studied the blood supply of the brain of rats and noticed that in the guinea pig the "post-natal spurt of capillary development" occurs earlier. Guinea pigs are more mature than rats when they are born. Their motor faculties are distinctly more advanced. Petren therefore raises the question of whether or not the development of capillary density in the motor cortex may perhaps be correlated with the general motor development of the animals.

Finally, Petren compared the rate of increase of capillary density in the motor cortex with the rate of increase of capillary length in the hearts of guinea pigs, using data obtained by him and Sylven in 1937. He found an impressive parallelism which, as he stresses, is undoubtedly significant. Capillary density in the heart muscle is closely correlated with the functional growth of the animals' skeletal musculature. "In the motor cortex and in the myocardium capillarisation appears to proceed along parallel lines. Both are functionally related to the skeletal musculature."

In 1936 Petren, together with Sjostrand and Sylven showed that physical training can increase capillary density of heart and skeletal musculature of young adult guinea pigs by 40-45 percent, 100 percent being the norm for a given age. In testing whether a similar morphological adjustment can be produced in the motor cortex, Petren investigated 77 adult guinea pigs aged 70 days and older. Of these 46 were used as controls, while 31 were induced to run on an automatically moving belt. The training of the animals was started when they were 2-3 weeks old and continued for a period of 2-3 months. The animals had to run every day once or twice for periods of half an hour at a speed of 60-64 meters per minute. Petren published the results of this study in a second paper which also appeared in 1938.

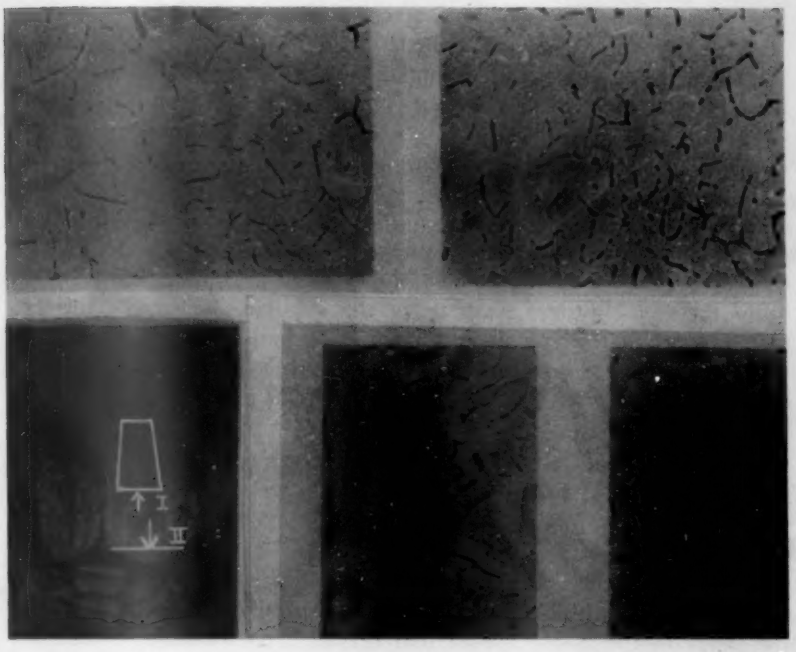

Fig. 1. (Top) Capillary density in motor cortex of untrained guinea pigs on 1st (left) and 35th day (right) of life. (Enlargement 1 x 122). Fig. 2. (Left, above) Brain of guinea pig viewed from above. Square to which arrow 1 points defines cortical motor area from which samples for histological study were taken. Portion posterior to line to which arrow 2 points, forms part of sensory cortex which was analysed for purpose of comparison. Fig. 3. (Right, above) Capillarisation of motor cortex in untrained (left) and trained (right) young adult guinea pigs (enlargement 1 x 80).

In this investigation capillary density was measured in two different parts of the cortex, *viz.*, in a motor and in a sensory area, as shown in Fig. 2, as well as in the anterior horn of the spine, samples being taken from the fifth cervical segment. Measurements of total capillary length were again expressed in terms of micra per .0027 cubic mm. of tissue.

In the *motor* cortex of the trained animals considerably greater capillary density was found than in the untrained controls (means of capillary length: 1730 and 1475 micra respectively). By contrast, there were no differences in the capillary supply of the *sensory* cortex (1570 and 1510 micra). But a marked superiority in capillary density was again discovered in the anterior horns of the spines of the trained as against those of the untrained guinea pigs, (1620 micra in the trained animals as against 1410 in the controls). "It is therefore established that muscular training, continued over a long time, causes an increase of capillary density of the motor cor-

tex. This increase is usually so great that even a glance at a microscopic specimen can decide whether the section was taken from a trained or from an untrained animal. Obviously new capillaries have been formed during the training," as shown in Fig. 3.

Petren contrasts the increase of capillarisation in the motor cortex with the absence of a corresponding reaction in the sensory cortex. This, he says, proves that the specific functional activity of the motor cortex, and not the general metabolic activation of metabolism, circulation, etc., through the exercise, is the causative agent. Needless to say, the discovery of a high degree of morphological adjustability through physical training of the capillary supply of the anterior horns of the spinal cord is of considerable importance, more especially in regard to the theory of physical therapy in post-poliomyelitic states.

In a third paper published with Alsen, Petren deals with the capillary supply of the cerebellum. Ninety guinea pigs were used, among them 50 fetuses. The born animals were between 1 and 112 days old.

As previously described for the motor cortex, so it was also found for the cerebellar cortex, *viz.*, that capillarisation develops rapidly during the last part of the fetal period. In contrast to what the study of the motor cortex had revealed, no increase of capillary density was observed in the cerebellum during the first 5 days of life. It is only during the second week and month following it that a spurt of capillary growth occurs corresponding to that seen in the motor cortex during the first few days of life. Similar results had been obtained by Craigie in his studies of the capillary supply of the pre-central and of the cerebellar cortex in rats. Apparently the cerebellum as a whole develops rapidly immediately after birth and during the first days capillary growth remains behind. Petren says that this discrepancy between total cerebellar and capillary growth is reflected in the conspicuous lack of coordination of their movements which the animals—rats as well as guinea pigs—show during the first days of life. A comparison of rates of capillary density in rats and guinea pigs led Petren to the conclusion that capillarisation of the cerebellar cortex reflects trends of growth of motor coordination. This concept is supported by the fact that during the early period of life the capillarisation of the motor cortex is well in advance of that of the cerebellum.

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The above papers contain bibliographic references which those who wish to follow up the subject should consult. The well known studies by E. H. Craigie are summarized in the following two publications:

Craigie, E. H., "Changes in Vascularity in the Brain Stem and Cerebellum of the Albino Rat between Birth and Maturity," *Journ. Comp. Neur.* 38 (1924-5).

————, "Postnatal Changes in Vascularity in the Cerebral Cortex of the Male Albino Rat," *Journ. Comp. Neur.* 39 (1925).

A comprehensive discussion of the vascular supply of nervous tissue is contained in the second edition of Professor W. E. Le Gros Clark's book *The Tissues of the Body* (Oxford, 1935, pp. 376 ff.). In the *Journal of Physical Education* (Stellenbosch, South Africa, November, 1945, pp. 8-13), the author of this review published an article "Petren on the Effect of Training and Pregnancy upon Capillarisation of Heart and Skeletal Musculature" in which the following three papers are summarized:

Petren, Ture., "Die Totale Anzahl der Blutkapillaren in Herzen und in der Skelettmuskulatur bei Ruhe und nach langer Muskeloebung; Verhandlungen der Anatomischen Gesellschaft auf der 43," *Versammlung in Jena,* vom 25, bis 28 (August, 1935). Anatomischer Anzeiger Bd. 81, Jena, 1935.

Petren, Ture, Torgny Sjostrand, und Bengt Sylven, "Der Einfluss des Trainings auf die Haufigkeit der Kapillaren in Hertz- und Skelettmuskulatur," *Arb. Physiol.* 9:4 (1936), p. 376-386.

Petren, Ture, und Bengt Sylven, "Der Einfluss der Graviditat auf die Kapillarenanzahl in der Herzmuskulatur," *Morphologisches Jahrbuch,* 78 (1936, Leipzig), 643-648.

Status of Physical Education in the High Schools of Illinois, 1945

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(Submitted for publication January, 1946)

PURPOSE

PERIODIC checking of actual conditions is commonly recognized as good business procedure. It was felt that such a "picture" of the status of physical education in the accredited secondary schools of Illinois would be of particular value in 1945 because of (1) the increased national emphasis on physical fitness, and (2) the enactment (1944) of the new Illinois physical education law. The purposes of this project were:

1. To determine the present status of such aspects of the program in physical education as distribution of student enrollment; number and distribution of new and beginning physical education teachers; training of physical education teachers in education, and in physical education; teacher load, i.e., number of academic classes taught per day by physical education teachers; extra teaching load (number of minutes per week spent in supervision of study hall and library, coaching, and similar activities); salaries; combinations of subjects taught.

2. To determine the progress made, if any, in the face of wartime difficulties toward compliance with provisions of the new state physical education law, i.e., number of schools offering physical education for boys and girls, time allotment (number and length of periods), and the number of schools requiring physical examinations.

All data for this study were obtained from the 1944-45 annual reports, which were submitted by principals of all public accredited high schools to the Office of the High School Visitor of the University of Illinois. Identical reports were filed with the State Superintendent of Public Instruction. Private schools and the Chicago high schools were omitted.

Enrollment groupings of the 700 accredited high schools of Illinois, exclusive of private and Chicago schools, used in the presentation were as follows: Group A, 1-99 students; Group B, 100-249; Group C, 250-499; Group D, 500-749; Group E, 750-999; Group F, 1,000-1,999; and Group G, over 2,000 students.

LIMITATIONS

Copies of visitation reports made by members of the State Physical Education Department at Springfield, when included, were invaluable in clarifying the existing situation in many high schools. However, where there were obvious discrepancies in the number of class periods, as indicated on the report and provision allowed on the class schedule, these were so indicated in the survey.

The study was further limited with respect to compilation of data on the teaching personnel in large school systems. Since schools employing more than twelve teachers are required by the High School Visitor and the State Department of Public Instruction to furnish full information only on new and beginning teachers, data necessary to obtain a complete picture of physical education teaching personnel were not available for most schools having an enrollment of 500 or more students. The data are, therefore, entirely limited to schools of the first three groups, except for information pertaining to new and beginning teaching personnel and the number and length of physical education class periods.

TABLE I

NUMBER AND DISTRIBUTION OF NEW AND BEGINNING TEACHERS OF PHYSICAL EDUCATION

Group		*A*	*B*	*C*	*D*	*E*	*F*	*G*	*Total*
Enrollment		1 – 99	100– 249	250– 499	500– 749	750– 999	1000– 1999	*Over* 2000	
Total schools		266	265	83	29	15	34	8	700
Number of	M	255	261	85*	....	....	....	..	.....
teachers	W	250	249	86	....	....	....	..	.....
No. beginning	M	16	22	6	1	0	2	0	47
teachers	W	64	59	18	5	0	4	2	152
No. teachers	M	56	52	16	3	2	10	2	141
new in system	W	47	56	15	8	4	16	4	150
Total beginning									
and new	M	72	74	22	4	2	12	2	188
teachers	W	111	115	33	13	4	20	6	302

EXPLANATION: Reading down, there were 266 schools included in group A having an enrollment of 1-99 students. These schools employed 255 men and 250 women physical education teachers. Of this number, 16 men and 64 women were beginning teachers—teaching for the first time. In addition, 56 men and 47 women, experienced teachers, were new in the system of a particular school. The total number of first year and new-in-the-system teachers was 72 men and 111 women.

* Schools with more than 12 teachers were required to furnish full information for teaching personnel only on new and beginning teachers. Group C had only 7 schools in his category. Data for this group, when not included on the report, were supplemented by counting the teachers on the class schedule. Groups D through G contain data on new or beginning teachers only.

DISCUSSION

An analysis of the data on the total number of boys and girls enrolled in the schools of each group, as indicated by the principal in his annual report, reveals that there were approximately 5 percent more girls than boys enrolled in secondary schools during the school year 1944-45. By contrast, a study made in 1939 of 440 accredited high schools in Illinois, indicated nearly 4 percent more boys than girls enrolled.[1]

Data in Table I reveal that there were 490 new and beginning physical education teachers in 652 Illinois public accredited high schools during the year 1944-45 (48 schools had no physical education teachers, 28 had no men instructors, and 40 had no women instructors). A breakdown of these figures show that of the 490 new and beginning teachers, 47 men and 152 women were teaching physical education in high schools for the first time. In addition to these first-year or beginning teachers, there were 291 new teachers, 141 experienced men and 150 experienced women, who were teaching their first year in a particular system. As was expected, an overwhelming proportion of the turnover came in schools of the first three groups (under 500 enrollment). Information was obtained

TABLE II

DISTRIBUTION OF SEMESTER HOURS OF PREPARATION OF PHYSICAL EDUCATION TEACHERS

A. Semester hours of preparation in education.

		All teachers			*New and beginning teachers*			
		Gr. A 1 – 99	Gr. B 100– 249	Gr. C 250– 499	Gr. D 500– 749	Gr. E 750– 999	Gr. F 1000– 1999	Gr. G Over 2000
Number teachers reporting	M	239	223	29	4	2	10	2
	W	232	219	39	14	4	20	6
Semester hours								
Mean	M*	41**	30	23	24	18	35	30
	W	23	23	23	25	23	26	26
Median	M	41	25	20	20	18	39	28
	W	22	21	21	23	23	25	21
Range	M	3–86	0–86	8–52	20–36	17–20	13–52	27–29
	W	2–52	0–63	7–50	16–50	18–30	11–59	15–43

*M—Men; W—Women.

**Decimals have been omitted to conserve space.

Explanation: Reading down in group A, schools enrolling 1 to 99 students, there were 239 men and 232 women teachers who reported their semester hours' preparation in education. The mean number of hours for men was 41, for women 23 semester hours. Median hours for men was 41, women 22. Range for men was from 3 to 86 semester hours, for women 2 to 52 semester hours.

1 C. O. Jackson. "Activities Engaged in by Teachers of Physical Education in the High Schools of Illinois, Part II," *Research Quarterly*, 14:1 (March, 1943), p. 68.

from 566 of the 614 schools in these three groups, which included approximately 88 percent of all schools in the study. Of the 601 men and 585 women employed to teach physical education in these three groups of schools, approximately 27 percent of the men and 44 percent of the women were new and beginning teachers. Slightly over one-fourth of the 27 percent turnover in men teachers were individuals teaching for the first time. Similarly, over one-half of the 44 percent turnover in women teachers were women teaching their first year.

The relatively high mean and medial hours for men in group A is attributed to the fact that one-half (129) of the total number of teachers in this group were principals.

TABLE III

B. Semester hours of preparation in physical education.

		All teachers			*New and beginning teachers*			
		Gr. A 1 – 99	Gr. B 100–249	Gr. C 250–499	Gr. D 500–749	Gr. E 750–999	Gr. F 1000–1999	Gr. G Over 2000
Number teachers reporting	M	114	143	21	4	2	7	2
	W	112	137	32	12	4	16	6
Semester hours								
Mean	M	12	20	18	18	45	28	39
	W	8	13	21	32	38	32	40
Median	M	10	16	16	18	45	24	39
	W	6	8	20	30	44	31	37
Range	M	0–71	0–60	0–70	15–21	21–70	12–69	26–52
	W	0–33	0–55	4–48	13–57	6–58	10–61	29–85

Explanation: Reading down in group A, schools enrolling under 100 students, 114 men and 112 women reported their preparation in physical education. The mean hours' preparation for men was 12, for women, 8. The median hours for men was 10, for women, 6. The range for men was from zero to 71, for women from zero to 33 semester hours.

In group A, out of 114 men reporting, 46 (40 percent) had less than 16 semester hours' preparation. Twenty-six (23 percent) had 5 or fewer hours, and 4 had no college preparation. In the same group, of 112 women reporting, 41 (36 percent) had less than 16 semester hours ; 52 (46 percent) had 5 or fewer hours, and 2 had no college preparation.

In group B, 143 men reporting, 42 (29 percent) had less than 16 semester hours of preparation. Fourteen (10 percent) had 5 or fewer hours, and 6 had no college preparation. Of the 137 women reporting in this group, 57 (41 percent) had less than 16 hours; 33 (24 percent) had 5 or fewer hours, and 5 had no college preparation. In the group as a whole, 82 (57 percent) of the men and 42 (30 percent) of the women had 16 or more semester hours' preparation.

In group C, 21 men reporting, 7 (33 percent) had less than 16 semester hours' preparation with only 2 having no college work. Of the 32 women reporting, 13 (40 percent) had less than 16 se-

mester hours and one with 5 or fewer hours of preparation. In the group, 12 (60 percent) of the men and 18 (56 percent) of the women had 16 or more semester hours of preparation.

Considering these three groups as a whole, 52 percent of the men and 72 percent of the women who reported, did not meet the state accrediting requirements as teachers of physical education.[2] On the other hand, the following summary of the foregoing data on physical education teachers who did meet the accrediting law indicates the increase in percentage from teachers in smaller to those in larger schools:

	16 or more sem. hrs.	
	Men	*Women*
Group A teachers	33%	15%
Group B teachers	57%	30%
Group C teachers	60%	56%

A similar study made of 440 secondary schools in 1937-38 indicated that more than one-third had not met state requirements.[3] Data obtained from teachers of the three groups (A, B, and C) in this study, show that nearly three-fourths did meet the state requirements. In all fairness, however, it must be pointed out that the 440 schools used in Jackson's study were a selected group, while there was no attempt made at selection in this study. It is a fact that the majority of unqualified physical education teachers were found in schools of less than 500 students, where it is obvious that teachers of physical education were primarily teachers of some subject other than physical education.

Many principals applied for and received temporary wartime emergency permits for physical education teachers who were inadequately prepared. This, however, was not wholly peculiar to the field of physical education, inasmuch as such permits were also issued for other teaching fields.

Teacher Load.—Data on teacher load reveal that of the 540 schools reporting in the first three groups of schools, 601 men and 585 women teachers of physical education were employed. This was slightly more than one man and one woman physical education instructor to a school. Of these 601 men, 6 percent (39) were full-time physical education instructors, 13 gave no information, and 8 were employed for one-half day only. Of the remaining 541, 11 percent taught one academic class, 23 percent taught 2 (this included many principals who also carried administrative duties), 33 percent taught 3, 22 percent taught 4, nearly 7 percent taught 5, and 6 instances were found where a teacher had been assigned 6 academic classes in addition to physical education. A majority of the men

2 "The Recognition and Accrediting of Illinois Secondary Schools," *University of Illinois Bulletin*, 8:8 (October, 1940), p. 53.

3 C. O. Jackson, "The Status of Physical Education in the Accredited Secondary Schools of Illinois," *Research Quarterly*, 9:1 (March, 1938), p. 56.

(55 percent) taught 3 or 4 academic classes per day.

The teaching load for women was comparable to that for men. There were 36 full-time instructors in schools in these 3 groups. Over one-half (60 percent) of the remaining women instructors were teaching 3 or 4 academic classes per day.

Extra Teaching Load.—Men spent an average of 10 hours a week on extra teaching duties such as study-hall supervision, library supervision, coaching, and other non-class activities. Women spent an average of five and one-half hours per week on such duties.

Salaries.—The salaries of physical education teaching personnel in schools of the first two groups have been listed under the headings of teachers having a combined experience of more than two years in all school systems; experienced teachers who were new in a system in 1945; and inexperienced teachers who began teaching in 1945. An examination of the data on men's salaries reveals a large number of principals in schools of the first two groups who were teaching physical education, obviously a wartime arrangement. Because of the added increment for administrative duties, salaries of these principals have been listed separately.

Significant facts concerning salaries of physical education teachers.—The median annual increment for beginning inexperienced men teachers in schools under 250 enrollment as shown in Table IV was from $200-$360 higher than the median annual increment of beginning inexperienced men teachers of all larger-sized schools. The median salary for beginning inexperienced women teachers was $1,700 in all groups of schools except two (500-999 enrollment) in which it dropped to $1,450.

Experience or length of service in a system had little effect or influence on salaries during the war. In most cases a slight benefit was given the inexperienced teacher.

Subject Combinations.—In 1939 Potthoff described conditions with respect to subject combinations as "chaotic."[4] It seems the situation still prevailed in 1944-45, at least in the case of physical education teachers. In group A (schools under 100 enrollment) 157 different combinations were tabulated for 251 men teachers, and 108 different combinations for 238 women. Group B (100-249 enrollment) had 134 different combinations for 229 men, 100 combinations for 228 women. Group C (250-499 enrollment) had 34 different combinations for 62 men, 28 combinations for 59 women. Further analysis of subject combination data make the following facts apparent: men taught a greater variety of subjects than women, the highest number of different combinations being in smaller schools; the most common combination for men was in the field of mathe-

4 Edward F. Potthoff, "Simplifying the Combinations of Subjects Assigned to High School Teachers," *University of Illinois Bulletin*, 36:87:13 (June, 1939).

TABLE IV

DISTRIBUTION OF SALARIES OF PHYSICAL EDUCATION TEACHERS IN SCHOOLS UNDER 250 ENROLLMENT*

	Size of high school enrollment							
	Group A 1-99				*Group B 100-249*			
	No. teachers reporting	*Salary*			*No. teachers reporting*	*Salary*		
		Mean	*Median*	*Range*		*Mean*	*Median*	*Range*
More than 2 yrs. experience, all systems								
Men P.E. teachers	76	$2233	$2216	$1500-3000	118	$2277	$2250	$1000-3300
Prin. tanght P.E.	95	2776	2800	1800-3660	29	2822	2770	1800-4200
Women P.E. teachers	122	1764	1800	1080-2200	101	1757	1775	1039-2400
Experienced, new in system, 1945								
Men P.E. teachers	27	2263	2250	1548-2850	50	2374	2500	1100-3000
Prin. taught P.E.	32	2612	2500	2000-3600	5	2840	2800	2600-3200
Women P.E. teachers	52	1762	1800	1350-2050	52	1729	1750	1080-2500
Inexperienced, beginning teacher 1945								
Men P.E. teachers	14	2194	2350	1350-2800	20	2251	2370	1215-2800
Prin. taught P.E.	2	2650	2650	2600-2700	0	.....	.....	.....-.....
Women P.E. teachers	61	1676	1700	1260-2040	59	1663	1700	1000-2000

*Salaries of new and beginning teachers in the remaining 5 groups of schools have been omitted in this report in order to conserve space.

matics, algebra-geometry, with social studies ranking second and third; analysis of the social studies data indicates a great many principals were teaching in this major field; the most common subject combinations for women were home economics and English.

Present Status of Provisions in the New Illinois State Physical Education Law.—The new physical education law states that,

> All pupils enrolled in the public schools . . . shall, as soon as practicable, be required to engage daily, during the school day, in courses of physical education for instructional periods, exclusive of recess and lunch periods and equal in length to the regular periods of the school day; or, where local conditions make it advisable, by a program of a total of two hundred (200) minutes weekly distributed over a period of three or four days . . . [5]

"Physical education classes" has been interpreted by the State Department of Physical Education as meaning periods of activity and if health instruction is included in the program, not more than 20 percent of the total time should be allowed for its teaching. Only a regularly scheduled class where actual teaching is being done is considered to be a physical education class.

In tabulating these data, if the principal indicated a certain number of periods for physical education and provisions were made for a like number of periods on his enclosed class schedule, the information was accepted as conclusive, so far as this study was concerned.

Of the 657 schools reporting on number and length of periods, 32 made no provision for boys' physical education classes. Similarly, of 648 schools reporting for girls, 42 schools made no provision for girls' classes. Many administrators frankly admitted on their reports that they were unable to carry out any type of program due either to the lack of gymnasium facilities or of qualified teachers. Two cases were found where the school had employed a coach on a part-time basis, who did no actual teaching. This is contrary to IHSA rules and was undoubtedly covered by a special permit.

It was noted that in all enrollment groups except two, there was a greater number of schools meeting the requirement on time allotment for boys than for girls. Many principals stated that in 1945 they had increased the time for boys by 2 or 3 periods per week, and the girls by 1 or 2. Several schools, lacking in gymnasium facilities and not included in these totals, indicated they would meet the requirement during the fall and spring months when the weather would permit outside classes.

Three hundred and seven (47 percent of the 657 schools reporting for boys were meeting the requirement on time allotment. Approximately 90 percent (275) of the 307 schools which were meeting the requirement on time allotment had daily periods. The remaining 32 schools were, however, meeting the minimum require-

[5] Illinois Health and Physical Education Law, Senate Bill 396.

ment of 200 minutes weekly. Two hundred and sixty-two (40 percent) of the 648 schools reporting for girls were meeting the requirement on time allotment. Nearly 90 percent (240) of the 262 schools had a daily program. The remaining 22 schools were meeting the minimum requirements.

Many schools, particularly those in groups E through G, did not carry on their program for the entire student body, but only for certain classes or combinations of classes, i.e., freshmen, seniors, freshmen-seniors, etc.

According to future plans, as indicated by principals, many schools will expand their programs as soon as qualified teachers are available.

Credit Allowed.—Over one-half (68 percent for boys, and 64 percent for girls) of the high schools were offering credit which counted toward graduation in 1945. It was impossible to determine from the data submitted on the annual reports, whether or not the information regarding the amount of credit referred to was for a part or all of the work taken, such as for one semester, or one, two, three, or four years, or whether the proposed credit was in addition to the credits now given, or the present schedule of requirements had been reduced to include physical education in the present total for graduation.

SUMMARY

The following statements summarize the conclusions reached from the study. The reader is reminded that in all comparisons, unless otherwise stated, the data for most of Group C and all of the last four groups are on new or beginning teachers.

1. Enrollment figures for 1944-45 indicated approximately 5 percent more girls than boys attended the secondary accredited schools of Illinois.

2. Schools represented in the first three groups had a turnover in 1944-45 of 27 percent for men physical education teachers, and 44 percent for women. About one-fourth of the 27 percent turnover in men were men teaching for the first time. Over one-half of the 44 percent turnover in women were women teachers teaching their first year. Schools under 500 enrollment had a much higher turnover in teachers than those represented in larger systems.

3. Although the range in semester hours' preparation in education showed considerable diversification, the mean and median hours for all men and women physical education teachers, including new and beginning teachers, remained fairly constant. The overall mean for men, with the exception of group A (129 principals), was 27.6 semester hours. Women had an overall average of 24.1.

4. Preparation in physical education, particularly in the first two groups of schools, was for the most part woefully inadequate.

In groups A, B, and C, 52 percent of the men and 72 percent of the women instructors did not meet the state requirements for teaching physical education in accredited high schools. It must be pointed out, however, that the majority of unqualified teachers were employed in schools of less than 500 students, where it is obvious that teachers of physical education were primarily teachers of some subject other than physical education. It is significant that the mean and median semester hours of preparation for both men and women show a gradual increase from teachers in smaller to those in larger schools. If these mean and median hours of preparation of beginning teachers in the larger-group schools can be used as criteria, the trend is toward better qualified teachers.

5. Data from 566 schools included in the first three groups (under 500 enrollment) reveal that there were only 39 men and 36 women employed as full-time physical education instructors. One-third of the total number of men who reported in these groups were teaching three academic classes per day. This number of classes was influenced by the fact that 34 percent of all teachers in groups A and B were principals who also carried an administrative load. Over one-half (60 percent) of all women taught three or four academic classes a day. A few instances were found where the instructor of physical education had been assigned 6, 7 and 8 academic classes.

6. Men teachers spent an average of 10 hours weekly as an extra teaching load in the supervision of study hall, library, coaching, and other extracurricular activities. Women spent an average of five and one-half hours weekly.

7. It is known that most of the larger schools obtained as new teachers, successful, experienced persons from smaller schools. The inducement is apparent; for example, in schools under 500 enrollment, the mean and median salaries of experienced new *men* in systems in 1945 for each group of schools was higher than for those men teachers who were in the system prior to this year. Only one inexperienced man and 6 inexperienced women were employed by schools of the three larger-sized groups.

Beginning teachers (both men and women) employed in small schools received equivalent or higher median salaries than beginning teachers in larger school systems.

Women's salaries showed a striking similarity in the mean and median for the various-sized groups of schools.

8. Conditions surrounding subject combinations in the teaching load were still chaotic in 1944-45. The following facts were apparent: men taught a greater variety of subjects than women, the highest number of different combinations being in smaller schools; the most common combination for men was algebra-geometry; for women, home economics and English.

9. Approximately two-thirds of all academic teaching loads of men physical education teachers can be grouped within the fields of social studies, science, and mathematics, in the order named. Nearly one-half of all teaching loads for women can be grouped within the fields of home economics and English.

10. The new Illinois state physical education law specifies daily periods, or a minimum of 200 minutes weekly. Data for boys from 657 accredited high schools in Illinois reveal that 307, or nearly one-half (47 percent), were meeting this part of the requirement. Approximately 90 percent (275) of the 307 schools meeting the requirement for boys reported having daily periods, while the remaining 32 schools were meeting the minimum requirements of 200 minutes weekly.

Data for girls reveal that 262 schools (40 percent) of the 648 reporting were meeting the requirement on time allotment. Ninety-one percent (240) reported daily periods, while the remaining 22 schools were meeting the minimum requirements of 200 minutes weekly.

Many principals frankly admitted on their reports that they were unable to carry out any type of program due either to the lack of gymnasia or of qualified teachers. Others, however, surmounted these obstacles by indicating plans to meet the requirement on time allotment during the fall and spring months when the weather would permit holding classes outside. The lack of qualified teachers prompted 3 schools to use a man teacher for girls' classes and 2 schools used a woman teacher for boys' classes. Other principals stated that they had increased the time for boys by 2 or 3 periods per week, and that for girls by 1 or 2 in 1945.

Many of the larger schools did not carry on their program for the entire student body, but only for certain classes or combination of classes, i.e., freshmen, freshmen-seniors, etc.

It is obvious that schools were trying to meet the requirements of the law; time was increased in many instances, but the supply of qualified teachers was limited. As a consequence, classes were assigned to many teachers irrespective of qualifications. The State Department gave such persons a great deal of help.

11. The new state law requires physical examinations for all students immediately prior to or upon entrance into the first grade and not less than every fourth year thereafter. Since data on physical examinations were not specifically called for in the annual report, only a comparatively few principals gave any information on this item. Many principals indicated, however, that they would give physical examinations if doctors could be secured. One hundred and thirty out of 700 schools reported giving examinations for boys and 127 for girls. This represents about 18 percent. Of these, the data

reveal that practically all required or gave examinations for either freshmen and beginning students, or for all students, representing about an equal division between the two.

12. Apparently more schools were applying credit in physical education in 1945 toward graduation than at any other time. Whether or not the amount of credit specified was on a par with academic credit offered—that is, the proposed credit be in addition to the credits now required for graduation, or the present schedule reduced to include physical education in the present total required for graduation—could not be determined. Most schools indicated one or one-fourth units.

Some Findings Resulting From The Army Air Forces Physical Training Program

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THE past war has resulted in many experiences demonstrating the correlation between physical fitness and military duties. Unfortunately, however, because of the difficulty of measurement or the inability to conduct experiments, most of these experiences were observational, and systematic records were not made. This report concerns an aspect of the recorded information on the AAF Physical Training Program during the war period, 1942-1945, namely, the results of the AAF Physical Fitness Testing Program. The report does not include any of the work conducted at the School of Aviation Medicine on physical fitness research.

Modern aerial warfare places a tremendous strain on the human body. This strain increases when operations are conducted under combat conditions and under unfavorable conditions of climate and hygiene. The human body, under normal living, is not trained to meet and withstand these physical, mental, and emotional drains and strains. Fortunately, however, the human organism is a highly adjustable organism, and, therefore, can be conditioned or trained to meet emergencies.

The nature and scope of the AAF Physical Training Program is resolved according to the following concept of physical fitness. Program materials were directed to this end.

1. *Organic Fitness.*—It was necessary to improve the physical fitness status of AAF personnel as much as ninety percent beyond entrance condition in order that they could meet the minimum AAF physical fitness standards. Organic fitness, according to the AAF definition, includes two components, namely, muscular strength and endurance, and cardiorespiratory endurance. A high degree of organic fitness yields a solid base for the development of aviation skills—pilot, navigator, gunner, bombardier, mechanic, etc. It also serves as a working basis for the effective utilization of the learned aviation skills. For example, a conditioned heart can supply more blood, therefore more O_2, to the tissues under normal O_2 pressure. This means a more effective human machine, both in respect to

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utilization of fuel and the need for fuel (less O_2 is needed per unit of work in a trained or conditioned individual). The criterion of organic fitness was a major one in the selection of activities for the physical training program. Administrative factors of time, personnel, equipment, etc., permitted participation in these activities of sufficient duration and intensity to cause the development of organic fitness according to established standards.

2. *Basic Skills.*—The development of such qualities as coordination, agility, balance, etc., was highly desirable in the AAF. Fitness in these traits probably affects the rate of learning aviation skills and the effectiveness of operation. Unfortunately, these skills are not easily developed. They result from training over a period of years, particularly in the early years (below 20 years). In the formulation of the AAF Physical Training Program, however, activities selected permitted practice of those factors in an effort to contribute as much as possible in training the individual how to utilize effectively his organic powers.

3. *Aquatic Skills.*—The development of aquatic skills represented one of the most urgent needs in the AAF, not only in the ability to swim, but in the utilization of artificial aids in remaining afloat. Approximately thirty to forty percent of the entering personnel in the AAF could not swim. Only about twenty-five percent had some skill in the ability to stay afloat using artificial aids. Realizing the seriousness of this problem, time was allowed in the AAF training Program for aquatic survival instruction. Had these skills been developed in schools and colleges before entrance into service, valuable training time could have been saved.

4. *Sport Skills.*—Approximately forty to fifty percent of personnel entering the AAF did not have a sufficient degree of skill in any sport to *desire* participation. The AAF Physical Training Program was therefore organized in a diagonal fashion, i.e., allowing more time to skill teaching and less time to conditioning activities as the training program progressed. It was with the thought of providing some leisure-time skills and a pleasant substitute for the conditioning activities which were necessary in *basic* conditioning that increased emphasis was placed on sport skills.

One of the major limitations of the AAF Physical Training Program, or any other short-period program, is in the development of the capacity for physical fitness. The degree to which one is able to *progress* and *achieve* physical fitness is determined partly by heredity and partly by training. If an individual desires to achieve the maximum limits set by heredity, it is necessary to begin physical participation at an early age—the earlier the better. A temporary loss due to lack of training can then be easily developed in programs such as the AAF Physical Training Program. However, a one- or

two-year program at the ages of 18 to 35 can do little in the realm of opening the potentiality of the individual for physical fitness. He can be developed to the limits of his present capacity, but that capacity could be considerably enlarged over a long-time training period (from early childhood through high school, especially).

ORGANIZATION AND ADMINISTRATION OF THE AAF PHYSICAL TRAINING PROGRAM

Realizing the importance of a superior state of physical fitness, the commanding general of the Army Air Forces issued directives establishing a physical training program.[1, 2, 3, 4] These directives defined organizational procedures, administrative techniques, program content, time allotment, physical fitness test procedures, physical fitness standards, and procedures on physical fitness research.

The commanding general of the AAF assigned to the assistant chief of air staff-training the responsibility for physical training. Policies were established in this office. These policies were accomplished in all echelons of command. Provisions were made for professionally trained personnel and physical training equipment and facilities in order to properly accomplish the directives. Arrangements were also made by the commanding general of the AAF for physical fitness research, the organization and administration of which has been described in another publication.[5]

The program materials of the AAF Physical Training Program consist of basic conditioning, aquatics, sports, and parachute-landing activities. These materials were arranged in appropriate proportion during the various stages of training and operation. During the early stages, emphasis was placed on basic conditioning activities with a balance of time allotted to skill teaching and sport participation. As personnel improved in physical fitness (as indicated by the AAF Physical Fitness Test) class time was allocated to basic conditioning and more time to the teaching of skills and participation in sports.

PHYSICAL FITNESS TESTING PROGRAM

It was recognized by those responsible for the construction of the AAF Physical Fitness Test that total fitness for war involved physical, emotional, intellectual, and social factors. All factors are interrelated and can only be separated for the convenience of analysis. The relative importance of each factor is determined by each job requirement. Realizing the interrelationship of these factors in

1 AAF Regulation 50-14: Training—Physical Training.
2 AAF Regulation 50-10: Training—Physical Fitness Test.
3 AAF Letter 50-57: Training—Survival Aquatics.
4 AAF Letter 15-21: Physical Fitness Research.
5 "The AAF Physical Fitness Research Program," *Research Quarterly*, 15:1 (March, 1944), pp. 12-15.

the performance of duties, it was nevertheless decided to consider only the physical factors on the premise that it was a first-order requirement to determine "what" one could do physically and not "why" he could not do it. The limitations are clearly realized, as the physical is influenced by the mental, social, and emotional factors. The physical factors were further delimited to include only the major organic constituents and did not include physical techniques (skills) on the effective utilization of the organic powers. The assumption underlying this procedure was that it was the responsibility of the AAF Physical Training Program to prepare personnel in the organic constituents underlying aviation skills and wartime physical needs and not physical skills having only a slight relationship to aviation duties and needs. With this in mind, the following constituents of physical fitness and tests were selected:

1. *Muscular Endurance.*—The capacity of the individual for long-continued contractions (submaximum) where a sufficient number of muscle groups are used with a sufficient duration and intensity to put a demand on the functions of circulation and respiration.

(a) Endurance Index: (Time for 60-yard x 6)—time for 360-yard run.*

2. *Muscular Endurance.*—The capacity of the individual to continue successive exertions under conditions where a load is placed on the muscle groups being tested.

(a) Chinning
(b) Dipping
(c) Sit-ups
(d) Leg-lifts
(e) Floor push-ups

3. *Muscular Explosiveness or Power.*—The capacity of the individual to release maximum force in the shortest period of time.

(a) Vertical jump
(b) Three standing broad jumps
(c) Shuttle race

4. *Agility.*—The capacity of the individual in the rate of changing position in space.

(a) Agility test (Burpee)

5. *Speed.*—The capacity of the individual in the rate of making successive movements of the same kind.

(a) 60-yard dash

6. *Body Coordination.*—The capacity of the individual to integrate movements of different kinds (different requirements for each phase of the activity) into one pattern.

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* The 360-yard run was used in this experiment, while the 300-yard shuttle run was finally selected for the AAF test. The correlation, however, is sufficiently high for such replacement. The reduction in distance is compensated by the *shuttle* procedure.

(a) Cozens' dodge run
(b) Baseball throw for distance and accuracy
(c) Direction change

7. *Speed and Endurance.*—The capacity of the individual to continue a maximum rate of speed over an extended distance.

(a) 360-yard run

The tests were administered to a representative sample of AAF personnel. The tests were intercorrelated, and each was correlated with the criterion measure (sum of all tests) as shown in Table I. The following criteria were used in the selection of the items for the AAF tests:

TABLE I

CRITERION CORRELATIONS, INTERCORRELATIONS, AND MULTIPLE CORRELATIONS OF VARIABLES FOR AAF TEST*

*Tests***	*Criterion Correlations*		*Constituents of Physical Fitness*
1. 60-yard Dash	.6775	1.	Speed
2. 360-yard Run	.7339	2.	Speed & Endurance
3. Endurance Index	.3379	3.	Endurance
4. a. Chinning	.6447	4.	Muscular End. (arm)
b. Floor Push-ups	.4970		
c. Dipping	.6323		
5. a. Sit-ups	.5422	5.	Muscular End. (Abdomen)
b. Leg Lifts	.3875		
6. a. Three Standing Broad Jumps	.6740	6.	Muscular Power
b. Vertical Jump	.6035		
c. Shuttle Run	.5885		
7. Agility (Burpee)	.5878	7.	Agility
8. a. Direction Change	.7347	8.	Body Coordination
b. Cozens' Dodge Run	.5473		
c. Baseball Throw for Distance	.5859		

r_{12}=.6173 r_{23}=.6684 r_{34}=.0658 r_{45}=.3221 r_{56}=.2699 r_{67}=.3046 r_{78}=.3492
r_{13}=.1113 r_{24}=.3499 r_{35}=.2645 r_{46}=.4766 r_{57}=.2945 r_{68}=.5095
r_{14}=.4805 r_{25}=.3939 r_{36}=.2420 r_{47}=.3699 r_{58}=.2818
r_{15}=.2847 r_{26}=.5205 r_{37}=.2551 r_{48}=.4047
r_{16}=.5142 r_{27}=.3777 r_{38}=.1890
r_{17}=.2913 r_{28}=.5314
r_{18}=.5728

*$R_{0.1234a5a6a78a}$=.9821 (Selected variable for each constituent of physical fitness, with 15 variable criterion)

$R_{0.24a5a}$=.86. (Variables selected from AAF test. 360-yard run was changed to 300-yard shuttle run for administrative reasons)

**The intercorrelations include only the first test in instances where more than one variable is used to measure the constituent of physical fitness.

1. Size of criterion correlation and degree of independence.
2. The closeness to normality of each distribution and the amount of variability.
3. Administrative economy.
4. Physical fitness content in tests.
5. Reliability.

After an analysis of several multiple combinations of test items, three tests were selected for the AAF test, namely, chinning, sit-ups, and a 300-yard shuttle run. The 300-yard shuttle run was selected in preference to the 360-yard straight-away run because of the ease of administration and also because, in some instances, a 360-yard straight-away was not available. The three tests correlated .86 with

TABLE II

ARMY AIR FORCES PHYSICAL TRAINING RECORD CARD

(Front)

Army Air Forces Physical Training Record Card

(Front)

1. NAME—Last name first—Print

2. RANK OR GRADE | 3. AGE (Years and months)

4. HEIGHT (Inches) | 5. ARMY SERIAL No. | 6. DATE (Entrance to AAF)

Physical Fitness Training Record

TEST No.	STATION	DATE	WEIGHT	PFR

Survival Aquatics Training Record

PROGRAM	STATION	DATE COMPLETED
A		
B		
C		
D		
E		

Parachute Landing Training Record

PHASE	STATION	DATE COMPLETED
Specialized		
Refresher		

Survival Training Record

TYPE	STATION	NUMBER OF HOURS
General		
Arctic		
Tropic		

(Back)

| Computation of Performance Scores, PFR Scores, and Rating | | | |

the criterion (sum of all selected tests). Norms were prepared, using a random and representative sample of AAF personnel as shown in Table II.

In order to make possible the administration of the AAF test indoors, an experiment was conducted on the selection of an indoor shuttle run. Shuttle runs of different lengths (150, 200, 250, 300 yards) and shuttle distances (15, 20, 25, 30 yards) were administered to a representative group of AAF personnel. After an intercorrelation analysis and correlation with the outdoor distance (criterion) the 250-yard run of 25-yard shuttle distance was selected. The correlation between the indoor and outdoor run (indoor to serve as substitute for outdoor during inclement weather) is .90. Either of the two runs was permitted in combination with chinning and sit-ups. Achievement scales for both runs are included on the test and record card as shown in Table II.

During the early stages of the AAF Physical Training Program, two standards of physical fitness were established, namely, PFR (Physical Fitness Rating) of 50, and PFR of 60. The former was considered a minimum standard, the latter a desirable one. Test results were transmitted to Headquarters, AAF, and analyzed on the basis of the two standards. As the program progressed, it became apparent that a correction was desirable. Standards were therefore prepared, taking cognizance of age, type of duty or training, and stage of training as indicated in Table III. The revised standards assumed dissimilar physical fitness requirements for the various AAF duties. It also assumed a varying problem in the development of physical fitness according to age and the length of time alloted to training.

RESULTS OF TESTING PROGRAM

Test results on all AAF personnel below 38 years of age were transmitted to Headquarters, AAF, for analysis and consolidation. The consolidated reports were forwarded to the commanding general of all continental command headquarters with appropriate comments. This procedure resulted in constant improvement in the physical fitness status of AAF personnel as shown in Table IV.

It will be noted in reviewing results of the testing program in Table IV that improvement in physical fitness resulted from progression of personnel in successive stages of training. A slight decline is noted following operational training. This is partly the result of a three-hour-per-week training program as compared to a six-hour-per-week program during individual training.

It is noted in Graph I* that ninety-two percent of the AAF pilot personnel reached or exceeded the AAF Physical Fitness Stand-

* All graphs will be found at end of article.

PHYSICAL FITNESS STATUS OF AAF

COMPARATIVE ANALYSIS WITH MAY 19

STAGE OF TRAINING OR OPERATION	AAF PERSONNEL CLASSIFICATION	PERCENTAGE ABOVE MINIMUM STANDARD FOR TOTAL AAF PERSONNEL (PFR SCORE 50 AND ABOVE) *	%
INDIVIDUAL TRAINING — SUCCESSIVE STAGES OF PRELIMINARY TRAINING	BTC TRAINING AND PRE-FLIGHT	1	80
		2	89
		3	87
		4	80
INDIVIDUAL TRAINING — SUCCESSIVE STAGES OF PILOT TRAINING	PRIMARY, BASIC, ADVANCED, SPECIALIZED, AND TRANSITORY	1	99.6
		2	99.7
		3	99.5
		4	99.5
INDIVIDUAL TRAINING — PARA-PILOT STAGES OF SPECIALIZED TRAINING	BOMBARDIER, NAVIGATION, AND GUNNERY	1	93
		2	95
		3	96
		4	94
TECHNICAL TRAINING	TECHNICAL AND FACTORY	1	82
		2	91
		3	90
		4	89
OPERATIONAL TRAINING AND ADMINISTRATION	GROUP AND ASSIGNED FLYING OFFICERS COMPOSITE FOR COMMANDS AND AIR FORCES	1	91
		2	90
		3	91
		4	92
OPERATIONAL TRAINING AND ADMINISTRATION	GROUP AND ASSIGNED FLYING ENLISTED COMPOSITE FOR COMMANDS AND AIR FORCES	1	77
		2	81
		3	84
		4	86

COMMANDS OR AIR FORCE	PERCENTAGE ABOVE MINIMUM STANDARD FOR COMMANDS AND AIR FORCES (PFR SCORE 50 AND ABOVE) *	%	PERCENTAGE ABOVE DESIRABLE STANDARD FOR COMMANDS AND AIR FORCES (PFR SCORE 60 AND ABOVE) *	%
BTC BASIC TRAINEES	1	26	1	5
	2	38	2	11
	3	59	3	31
	4	79	4	53
BTC CAREER GUNNERS	2	79	2	57
	3	96	3	89
	4	94	4	67
BTC PRE-AVIATION	1	50	1	14
	2	72	2	40
	3	68	3	27
	4	64	4	21
PRE-FLIGHT	1	99.2	1	90
	2	99	2	90
	3	97	3	80
	4	97	4	79
PRIMARY	1	99.8	1	95
	2	99.9	2	97
	3	99.8	3	96
	4	99.6	4	91
BASIC	1	99.9	1	96
	2	99.9	2	98
	3	99.5	3	98
	4	99.8	4	99
ADVANCED	1	99.9	1	98
	2	99.9	2	98.5
	3	99.9	3	99
	4	100	4	99.8
TRAINING COMMAND — TRAINING COMMAND	1	99.9	1	90
	2	99	2	90
	3	99	3	89.5
	4	99	4	94
TRAINING COMMAND — 24 & 34 AIR FORCES	2	99	2	94
	3	95	3	83
	4	94	4	79
TRANSITIONAL	1	95	1	84
	2	99.8	2	98
	3	100	3	98
	4	100	4	98
BOMBARDIER	1	99.7	1	95
	2	99.9	2	97
	3	99.9	3	99
	4	100	4	99.8
NAVIGATION	1	99	1	83
	2	99.4	2	92
	3	99.7	3	95
	4	99.7	4	98
GUNNERY	1	90	1	62
	2	93	2	71
	3	94	3	75
	4	92	4	71
TECHNICAL SCHOOLS	1	82	1	47
	2	92	2	71
	3	90	3	67
	4	89	4	61
FACTORY SCHOOLS	1	81	1	44
	2	85	2	57
	3	89	3	61
	4	87	4	57
1st, 2nd, 3rd & 4th AIR FORCES I TROOP CARRIER COMMAND	1	91	1	65
	2	92	2	67
	3	96	3	76
	4	91	4	62
AIR TRANSPORT COMMAND	1	77	1	27
	2	76	2	30
	3	80	3	31
	4	87	4	35
PROVING GROUND COMMAND AAF CENTER	1	57	1	10
	2	72	2	19
	3	65	3	13
	4	83	4	35
TRAINING COMMAND — FLYING TRNG	1	93	1	59
	2	93	2	63
	3	90	3	61
	4	94	4	74
TRAINING COMMAND — TECH TRNG	1	93	1	56
	2	84	2	52
	3	78	3	36
	4	86	4	49
1st, 2nd, 3rd & 4th AIR FORCES I TROOP CARRIER COMMAND	1	77	1	31
	2	80	2	41
	3	85	3	44
	4	88	4	54
AIR TRANSPORT COMMAND	1	66	1	17
	2	67	2	20
	3	66	3	17
	4	74	4	18
PROVING GROUND COMMAND AAF CENTER	1	50	1	9
	2	53	2	14
	3	42	3	6
	4	64	4	16

STAGE OF TRAINING OR OPERATION	AAF PERSONNEL CLASSIFICATION	PERCENTAGE ABOVE MINIMUM STANDARD FOR TOTAL AAF PERSONNEL (PFR SCORE 50 AND ABOVE) *	%
OPERATIONAL TRAINING AND ADMINISTRATION - (Continued)	GROUP NON-FLYING OFFICERS COMPOSITE FOR COMMANDS AND AIR FORCES	1	68
		2	68
		3	70
		4	73
	GROUP NON-FLYING ENLISTED COMPOSITE FOR COMMANDS AND AIR FORCES	1	55
		2	55
		3	53
		4	56
	BASE OFFICERS COMPOSITE FOR COMMANDS AND AIR FORCES	1	67
		2	73
		3	69
		4	73
	BASE ENLISTED COMPOSITE FOR COMMANDS AND AIR FORCES	1	38
		2	51
		3	51
		4	53

S OF AAF PERSONNEL

S WITH MAY 1945

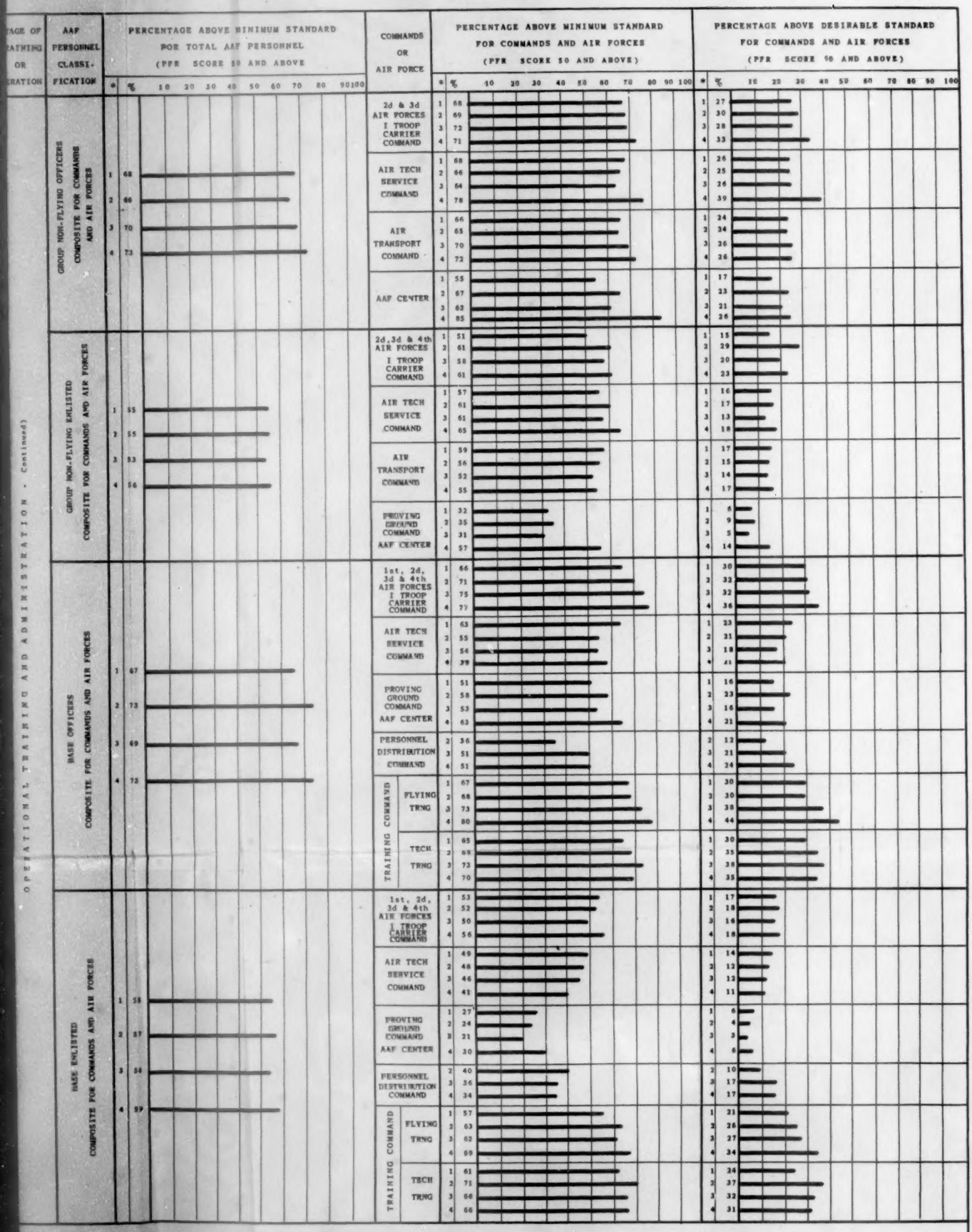

OPERATIONAL TRAINING AND ADMINISTRATION - Continued)
AAF PERSONNEL CLASSIFICATION
PERCENTAGE ABOVE MINIMUM STANDARD FOR TOTAL AAF PERSONNEL (PFR SCORE 50 AND ABOVE)
COMMANDS OR AIR FORCE
PERCENTAGE ABOVE MINIMUM STANDARD FOR COMMANDS AND AIR FORCES (PFR SCORE 50 AND ABOVE)
PERCENTAGE ABOVE DESIRABLE STANDARD FOR COMMANDS AND AIR FORCES (PFR SCORE 90 AND ABOVE)
GROUP NON-FLYING OFFICERS COMPOSITE FOR COMMANDS AND AIR FORCES
1 68
2 66
3 70
4 73
2d & 3d AIR FORCES 1 68 2 69 3 72 4 71 | 1 27 2 30 3 28 4 33
I TROOP CARRIER COMMAND 1 68 2 66 3 64 4 78 | 1 26 2 25 3 26 4 39
AIR TECH SERVICE COMMAND 1 66 2 65 3 70 4 72 | 1 24 2 24 3 26 4 26
AIR TRANSPORT COMMAND 1 55 2 67 3 63 4 85 | 1 17 2 23 3 21 4 26
AAF CENTER
GROUP NON-FLYING ENLISTED COMPOSITE FOR COMMANDS AND AIR FORCES
1 55
2 55
3 53
4 56
2d,3d & 4th AIR FORCES 1 51 2 61 3 58 4 61 | 1 15 2 29 3 20 4 23
I TROOP CARRIER COMMAND 1 57 2 61 3 61 4 65 | 1 16 2 17 3 13 4 18
AIR TECH SERVICE COMMAND 1 59 2 56 3 52 4 55 | 1 17 2 15 3 14 4 17
AIR TRANSPORT COMMAND 1 32 2 35 3 31 4 57 | 1 6 2 9 3 5 4 14
PROVING GROUND COMMAND AAF CENTER
BASE OFFICERS COMPOSITE FOR COMMANDS AND AIR FORCES
1 67
2 73
3 69
4 73
1st, 2d, 3d & 4th AIR FORCES 1 66 2 71 3 75 4 77 | 1 30 2 32 3 32 4 36
I TROOP CARRIER COMMAND 1 63 2 55 3 54 4 39 | 1 23 2 21 3 18 4 21
AIR TECH SERVICE COMMAND 1 51 2 58 3 53 4 63 | 1 16 2 23 3 16 4 21
PROVING GROUND COMMAND AAF CENTER 2 36 3 51 4 51 | 2 12 3 21 4 24
PERSONNEL DISTRIBUTION COMMAND
TRAINING COMMAND FLYING TRNG 1 67 2 68 3 73 4 80 | 1 30 2 30 3 38 4 44
TRAINING COMMAND TECH TRNG 1 65 2 69 3 73 4 70 | 1 30 2 35 3 38 4 35
BASE ENLISTED COMPOSITE FOR COMMANDS AND AIR FORCES
1 58
2 57
3 54
4 59
1st, 2d, 3d & 4th AIR FORCES 1 53 2 52 3 50 4 56 | 1 17 2 15 3 16 4 18
I TROOP CARRIER COMMAND 1 49 2 48 3 46 4 41 | 1 14 2 13 3 12 4 11
AIR TECH SERVICE COMMAND 1 27 2 24 3 21 4 30 | 1 6 2 4 3 3 4 6
PROVING GROUND COMMAND AAF CENTER 2 40 3 36 4 34 | 2 10 3 17 4 17
PERSONNEL DISTRIBUTION COMMAND
TRAINING COMMAND FLYING TRNG 1 57 2 63 3 62 4 69 | 1 21 2 26 3 27 4 34
TRAINING COMMAND TECH TRNG 1 61 2 71 3 66 4 66 | 1 24 2 37 3 32 4 31

TABLE III

AAF Physical Fitness Standards

	Personnel Classification	*AAF Physical Fitness Standards (PFR Scores)*	
Trainees	Officers, aviation cadets, and aviation students, upon completion of final phase of pilot, navigator, bombardier, and flexible gunnery training within the AAF Training Command	66	
	Combat air crew member trainees within the continental air forces	60	
	All other trainees	Age 28 & below	60
		Above 28 years	55
Rated Personnel Other Than Trainees	Rated officers and enlisted personnel on flying status	Age 28 & below	60
		Above 28 years	55
	Rated officers and enlisted personnel not on flying status	Age 28 & below	55
		Above 28 years	50
Nonrated Personnel Other Than Trainees	Nonrated officer and enlisted personnel qualified for overseas duty	Age 30 & below	55
		Above 30 years	50

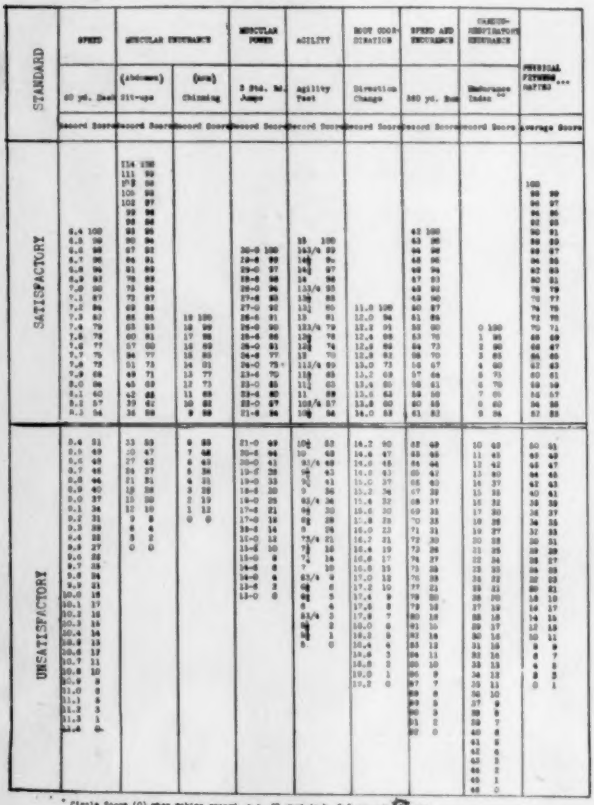
ard of 66 established for these personnel as shown in Table III. It is also noted that only twenty-three percent of these personnel reached or exceeded this standard at the beginning of training in the AAF (Basic Training Center). The successive stages of training for pilots represented approximately a period of one year.

CHRONOLOGICAL AGE AND PHYSICAL FITNESS

The analysis pertaining to chronological age is based on an eight-item physical fitness test as shown in Table V. The analysis also concerns, in part, four populations of the AAF, namely, the noncommissioned officers' physical training school personnel, officers' candidate school, officer training school, and basic training center personnel. The age range for these various groups was 18 to 47 as outlined in Graphs II to X. The Index Score (sum of the 8 items) served as a measure of physical fitness of these groups. The analysis of physical fitness and age consists not only of total fitness (index

TABLE V

Physical Fitness Index Applied in the Analysis of Chronological Age



STANDARD	SPEED	MUSCULAR ENDURANCE		MUSCULAR POWER	AGILITY	BODY COORDINATION	SPEED AND ENDURANCE	CARDIO-RESPIRATORY ENDURANCE	PHYSICAL FITNESS *** RATING
	60 yd. Dash	(Abdominal) Sit-ups	(Arm) Chinning	3 Std. Bd. Jump	Agility Test	Direction Change	300 yd. Run	Endurance Index **	
	Record Score	Record Score	Record Score	Record Score	Record Score	Record Score	Record Score	Record Score	Average Score
SATISFACTORY	6.4 100 6.5 99 6.6 98 6.7 96 6.8 94 6.9 92 7.0 90 7.1 87 7.2 84 7.3 82 7.4 79 7.5 76 7.6 73 7.7 70 7.8 67 7.9 64 8.0 60 8.1 56 8.2 52 8.3 48	114 100 111 99 108 98 105 96 102 94 99 92 96 90 93 88 90 86 87 84 84 81 81 78 78 75 75 72 72 67 69 62 66 57 63 52 60 47 57 42 54 37 51 32 48 27 45 23 42 18 39 12 36 08	19 100 18 99 17 98 16 96 15 95 14 93 13 92 12 90 11 89 10 87 9 86	30-0 100 29-6 99 29-0 97 28-6 96 28-0 94 27-6 93 27-0 92 26-6 91 26-0 90 25-6 88 25-0 87 24-6 86 24-0 84 23-6 83 23-0 82 22-6 80 22-0 79 21-6 78	15 100 14 1/4 99 14 98 14 96 13 3/4 95 13 93 13 92 12 3/4 91 12 89 12 3/4 88 12 86 12 3/4 85 12 83 11 3/4 82 11 80 11 3/4 79 11 77 10 3/4 76 10 74 10 3/4 73 10 71 10 3/4 70 10 68 9 3/4 67 9 65 9 3/4 64 9 62 9 3/4 61 9 59	11.0 100 11.2 98 11.4 96 11.6 94 11.8 92 12.0 90 12.2 88 12.4 86 12.6 84 12.8 82 13.0 80 13.2 78 13.4 76 13.6 74 13.8 72 14.0 70	42 100 43 98 44 96 45 94 46 92 47 90 48 88 49 86 50 84 51 82 52 80 53 78 54 76 55 74 56 72 57 70 58 68 59 66 60 64 61 62 62 60 63 58 64 56 65 54 66 52 67 50 68 48 69 46 70 44 71 42 72 40 73 38 74 36 75 34 76 32 77 30 78 28 79 26 80 24 81 22 82 20 83 18 84 16 85 14 86 12 87 10 88 08	0 100 1 98 2 96 3 94 4 92 5 90 6 88 7 86 8 84 9 82 10 80 11 78 12 76 13 74 14 72 15 70 16 68 17 66 18 64 19 62 20 60 21 58 22 56 23 54 24 52 25 50 26 48 27 46 28 44 29 42 30 40 31 38 32 36 33 34 34 32 35 30 36 28 37 26 38 24 39 22 40 20 41 18 42 16 43 14 44 12 45 10 46 08 47 06 48 04 49 02 50 00	100 99 99 98 97 97 96 96 95 95 94 94 93 93 92 92 91 91 90 90 89 89 88 88 87 87 86 86 85 85 84 84 83 83 82 82 81 81 80 80 79 79 78 78 77 77 76 76 75 75 74 74 73 73 72 72 71 71 70 70 69 69 68 68 67 67 66 66 65 65 64 64 63 63 62 62 61 61 60 60 59 59 58 58 57 57 56 56 55 55 54 54 53 53 52 52 51 51 50 50 49 49 48 48 47 47 46 46 45 45 44 44 43 43 42 42 41 41 40 40 39 39 38 38 37 37 36 36 35 35 34 34 33 33 32 32 31 31 30 30 29 29 28 28 27 27 26 26 25 25 24 24 23 23 22 22 21 21 20 20 19 19 18 18 17 17 16 16 15 15 14 14 13 13 12 12 11 11 10 10 09 09 08 08 07 07 06 06 05 05 04 04 03 03 02 02 01 01 00
UNSATISFACTORY	6.4 31 6.5 29 6.6 28 6.7 26 6.8 24 6.9 23 7.0 21 7.1 19 7.2 18 7.3 16 7.4 14 7.5 13 7.6 12 7.7 11 7.8 10 7.9 9 8.0 8 8.1 6 8.2 5 8.3 4 8.4 3	33 33 30 47 27 62 24 77 21 91 18 08 15 22 12 36 9 8 6 4 3 0 0 0	8 33 7 16 6 00 5 16 4 33 3 50 3 06 2 23 1 40 0 56	21-0 69 20-6 68 20-0 67 19-6 66 19-0 65 18-6 64 18-0 63 17-6 61 17-0 60 16-6 59 16-0 58 15-6 57 15-0 56 14-6 54 14-0 53 13-6 52 13-0 51	10 3/4 63 10 62 11 3/4 60 11 59 11 3/4 58 12 56 12 3/4 55 12 53 12 3/4 52 13 50 13 3/4 49 13 47 13 3/4 46 14 44 14 3/4 43 15 41 15 3/4 40 16 38 16 3/4 37 17 35 17 3/4 34 18 32 18 3/4 31 19 29 19 3/4 28 20 26 20 3/4 25 21 23 21 3/4 22 22 20 22 3/4 19 23 17 23 3/4 16 24 14 24 3/4 13 25 11 25 3/4 10 26 08 26 3/4 07 27 05 27 3/4 04 28 02 28 3/4 01 29 00	16.2 50 16.4 47 16.6 45 16.8 43 17.0 41 17.2 39 17.4 36 17.6 34 17.8 32 18.0 30 18.2 28 18.4 25 18.6 23 18.8 21 19.0 19 19.2 17 19.4 14 19.6 12 19.8 10 20.0 08 20.2 06 20.4 03 20.6 01 20.8 00	68 48 69 46 70 44 71 42 72 40 73 38 74 36 75 34 76 32 77 30 78 28 79 26 80 24 81 22 82 20 83 18 84 16 85 14 86 12 87 10 88 08 89 06 90 04 91 02 92 00	10 48 11 46 12 44 13 42 14 40 15 38 16 36 17 34 18 32 19 30 20 28 21 26 22 24 23 22 24 20 25 18 26 16 27 14 28 12 29 10 30 08 31 06 32 04 33 02 34 00	50 51 51 50 52 49 53 48 54 47 55 46 56 45 57 44 58 43 59 42 60 41 61 40 62 39 63 38 64 37 65 36 66 35 67 34 68 33 69 32 70 31 71 30 72 29 73 28 74 27 75 26 76 25 77 24 78 23 79 22 80 21 81 20 82 19 83 18 84 17 85 16 86 15 87 14 88 13 89 12 90 11 91 10 92 09 93 08 94 07 95 06 96 05 97 04 98 03 99 02 100 01

* Circle Score (0) when making record, e.g. 60 yard dash 9.2 sec. = 0% on the 6.4 sec. etc.
** End. Index : Time for 300 yd. run - (time for 60 yd. dash x 5) = Endurance Index ; 300 - (7.0 x 5) = 10 seconds.
*** Physical Fitness Rating equal to 0 circled scores (average).

score) but also the relationship of the various selected components of physical fitness and chronological age. It is reasonable to suspect that the retrogression of physical fitness may not be of the same magnitude in each component of fitness.

A progressive and uniform retrogression in physical fitness with increase in chronological age is found with respect to the total index and each component of physical fitness. The review of Graph II will reveal some facts concerning physical fitness and age. The physical training personnel, due to their daily leadership in conditioning AAF personnel, have a higher degree of physical fitness than the other personnel groups for some age periods. A significant fact in this analysis is that the loss of physical fitness with increase of age

is not as great as the loss of physical fitness with increase in age in the less conditioned groups (over same age range). This fact has tremendous physiological significance in the relationship of the role of exercise to efficiency with increase in age. It is quite probable that exercise has a much larger connotation to health than just being able to perform tasks calling for large amounts of muscular strength, endurance, agility, etc. Another fact of significance is the immediate decline of performance fitness, following the first year analyzed (18-year-old group). It has been recognized by physiologists and facts resulting from participation in sports that peaks of physical performances vary with the sport, depending on the physical qualities required for participation in the sport. It is difficult, however, to understand the decline in performance fitness of muscular strength, endurance, etc., following the eighteenth year. A probable reason for such a decline is a lack of participation in physical activities after leaving school and after leaving home communities. This explanation seems to be somewhat refuted by noting the decline of physical fitness in the physical training group following the twenty-one-year-old group. The implications and causes of these findings will need further research.

It will be noted in Graph II that percentage analysis is used to indicate the magnitude in the decline of physical fitness. Such an analysis is in order if it is considered only with respect to the group analyzed. Because the base point references differ in each group, the percentage values are not comparable between groups. It is significant to note however, the general downward trend of these percentages.

The analysis of physical fitness and chronological age also includes the selected components of physical fitness, namely, speed, muscular endurance, muscular power, agility, gross body coordination, speed and endurance, and cardiorespiratory endurance. The AAF population used in this analysis consists of the OTS personnel and OCS personnel. It was decided to drop the physical training group as being atypical and the BTC due to the influence of GI shoes on some of the test performances, thereby causing a significant difference between the groups for similar age periods. The OTS and OCS groups, for the same age period, have insignificant differences, and therefore were combined.

It is noted in reviewing Graphs II to X that a progressive regression is found in each component of physical fitness with increase in chronological age. Information as to the comparative degree of loss of physical fitness as it pertains to each component is not presented. Each graph has independent interpretations and implications. At some later date the basic data will be translated to standard scores in order that a comparative analysis can be made with

respect to the various components of physical fitness. At present, it will suffice to say that retrogression in each component of physical fitness begins immediately after the first year group analyzed (18-year-old group). Two hypotheses can be advanced in explanation for the nature of this loss: (1) that the phenomenon is a physiological one and that performance fitness physiologically retrogresses after the eighteenth year; and (2) that the results show a lack of physical conditioning due to recent release from school influences and/or the lack of the recreational influences of the home community. The latter seems more plausible. The real test for relationship of chronological age and physical fitness is either a year-by-year analysis of a group maintaining a maximum degree of physical fitness, or the maximum conditioning of groups for each year which have been equalized in the various factors which cause the development of physical fitness. If it can be assumed that the exercise life of the personnel in the two selected AAF groups (OTS and OCS) was of the same magnitude in civilian life, then the retrogression shows physiological deterioration in performance fitness immediately after the eighteenth year.

CONCLUSIONS

1. The AAF Physical Fitness Test, constructed by using the conventional scientific procedures of test construction, was found to satisfactorily serve the AAF Physical Training Program in meeting the major objective, namely, the development of an optimum degree of physical fitness. The system of reports citing AAF personnel needs served as one of the greatest motivating forces.

2. The experience of the AAF Testing Program clearly demonstrates the high relationship between achievement of objectives and the use of test results. The testing program, however, must be prepared according to the dictates of existing conditions. The amount of validity for the testing procedures must also vary according to existing conditions. It is not an all-or-none phenomenon.

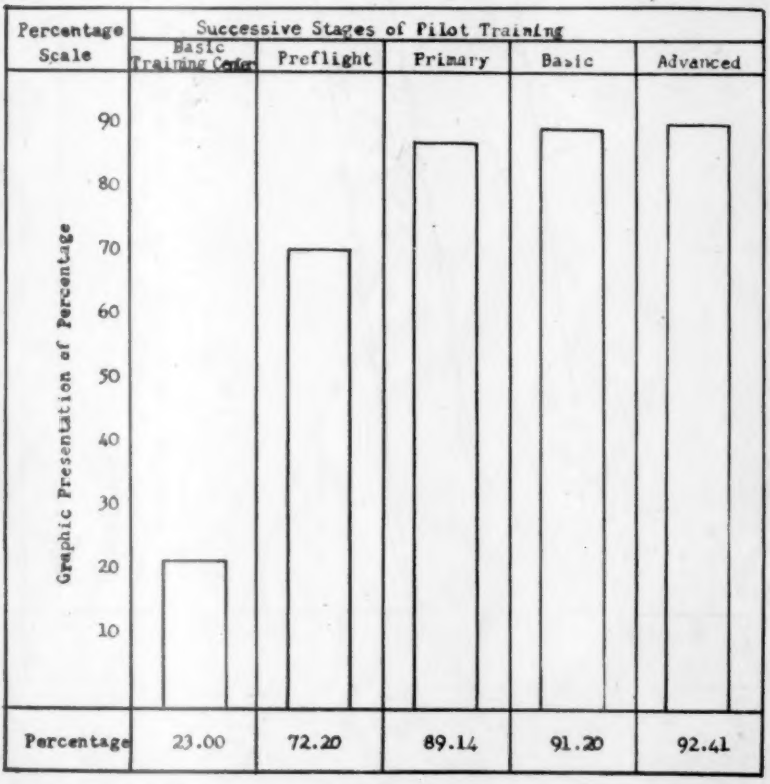
3. The experience of the AAF Testing Program also shows the desirability of not only preparing norms for AAF personnel but also *standards for achievement* for the various personnel groups. These standards should take cognizance of chronological age, stage of training, and the nature of duties.

4. An eight-item physical fitness test is reported and is applicable in programs where a diagnostic emphasis is desired. The AAF Physical Fitness Test index score correlates .86 with the same criterion, which is sufficiently high to permit the use of the index score as a measure of physical fitness according to the selected variables. Directions for the eight-item test may be procured from the writer.

5. Periodic reports (four reports during a period of one year) show systematic and significant improvement of physical fitness in

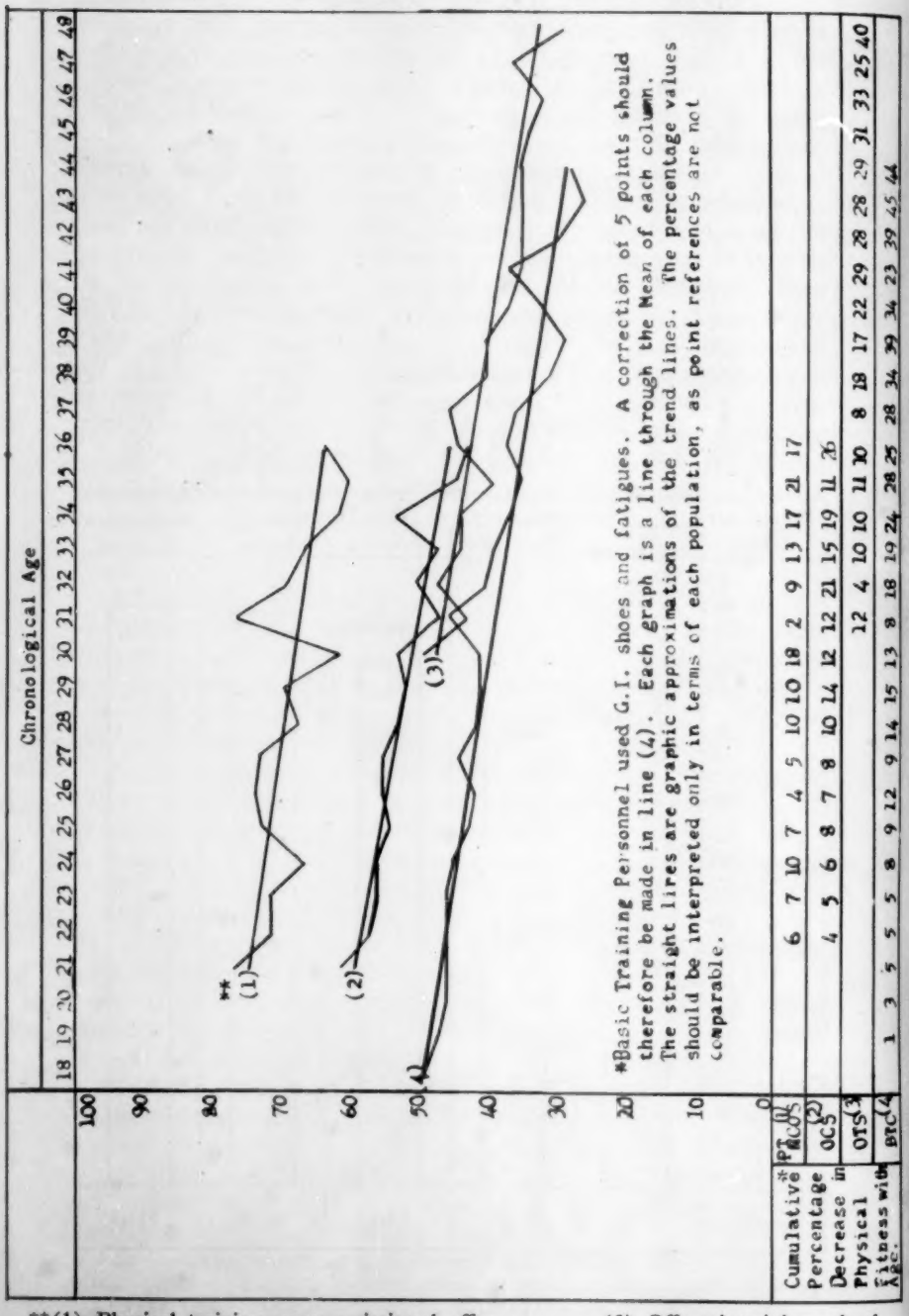
each succeeding stage of training. Over a period of approximately one year, pilot personnel improved from 23 percent, reaching or exceeding a PFR score of 66, to 92 percent, reaching or exceeding this PFR standard. A slight reduction in physical fitness is found in operational training, due in part to a reduction in time for physical training from six hours per week to three hours per week.

6. A systematic retrogression in physical fitness with increase in chronological age is found with respect to the total index score and the eight components of physical fitness used to yield the index score. The retrogression begins immediately following the first age groups analyzed—the 18-year-old group. Two hypotheses are advanced as a probable explanation for this phenomenon: (1) that the phenomenon is a physiological one and that performance fitness physiologically retrogresses after the eighteenth year; and (2) that the results show a lack of physical conditioning, due to recent release from school influences and/or lack of the recreational influences of the home community. The latter seems more plausible.



GRAPH I. PERCENTAGE OF PILOT TRAINING PERSONNEL REACHING OR EXCEEDING PFR STANDARD OF 66. (TRAINING PERIOD APPROXIMATELY ONE YEAR.)

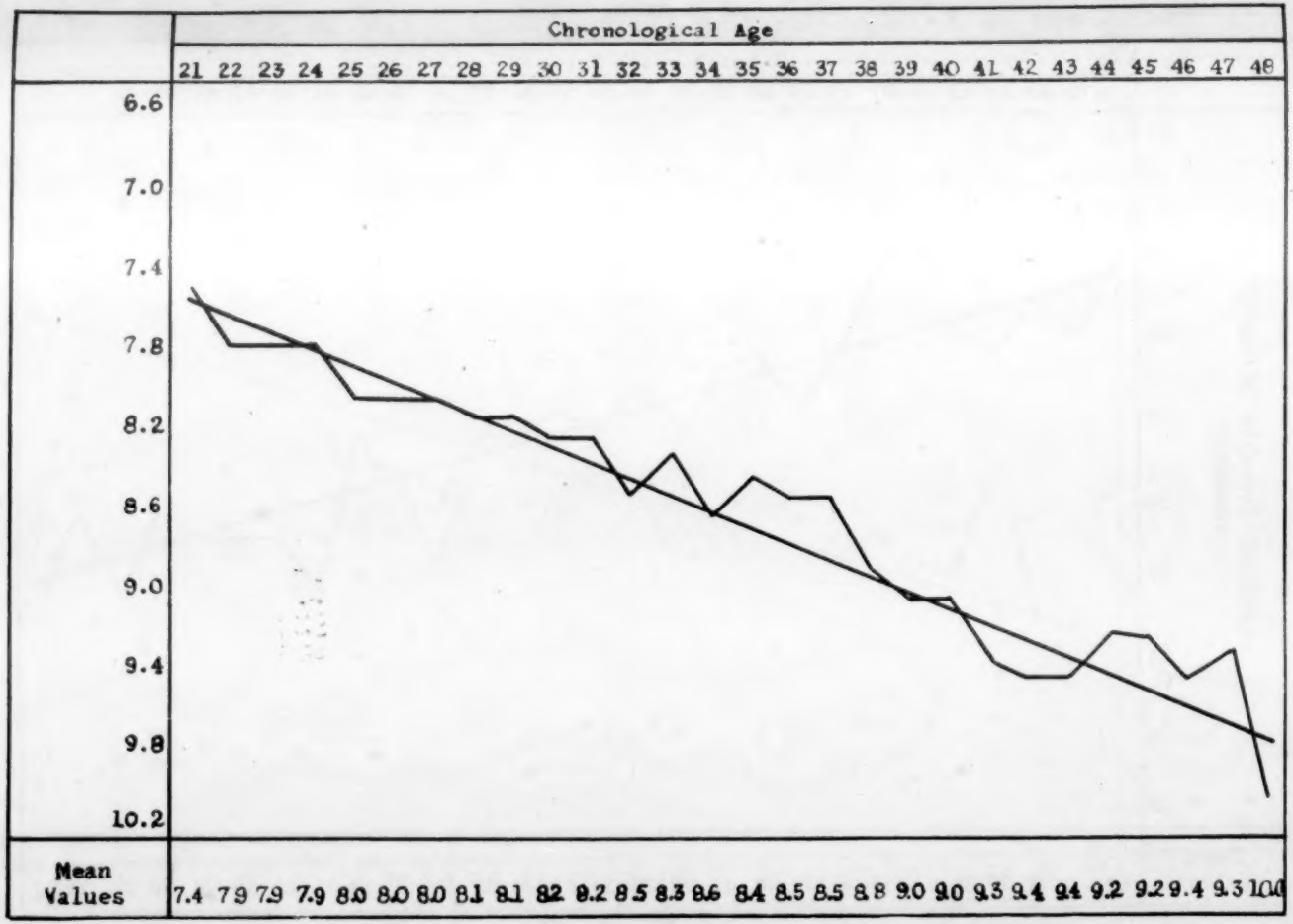
GRAPH II. CHRONOLOGICAL AGE AND PHYSICAL FITNESS.*


Chronological Age
18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49
100 90 80 70 60 50 40 30 20 10 0
**(1)
(2)
(3)
(4)
*Basic Training Personnel used G.I. shoes and fatigues. A correction of 5 points should therefore be made in line (4). Each graph is a line through the Mean of each column. The straight lines are graphic approximations of the trend lines. The percentage values should be interpreted only in terms of each population, as point references are not comparable.
Cumulative* Percentage Decrease in Physical Fitness with Age.
PT (1) 6 7 10 7 4 5 10 10 18 2 9 13 17 21 17
OCS (2) 4 5 6 8 7 8 10 14 12 12 21 15 19 11 26
OTS (3) 12 4 10 10 11 10 8 18 17 22 29 28 28 29 31 33 25 40
BTC (4) 1 3 5 5 5 8 9 12 9 14 15 13 8 18 19 24 28 25 28 34 39 34 23 39 45 44

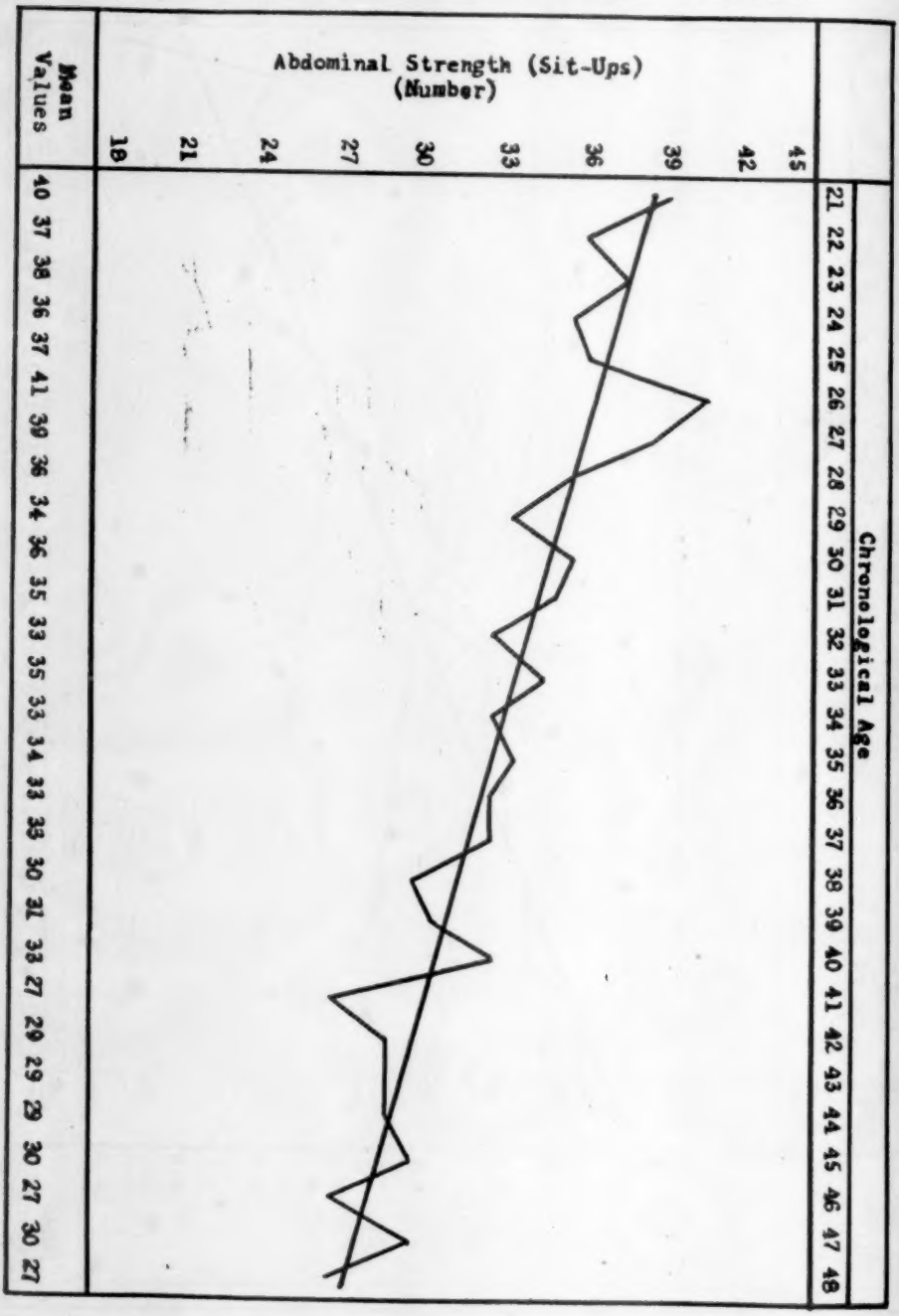
**(1) Physical training noncommissioned officers
(2) Officer candidate school
(3) Officers' training school
(4) Basic training center

		Chronological Age																												
		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
Decrease in Physical Fitness with Age.	OCS[3]																													
	OTS[3]															12	4	10	10	11	10	8	18	17	22	29	28	28	29	31	33	25	40
	BTC[4]	1	3	5	5	5	8	9	12	9	14	15	13	8	18	19	24	28	25	28	34	39	34	23	39	45	44			

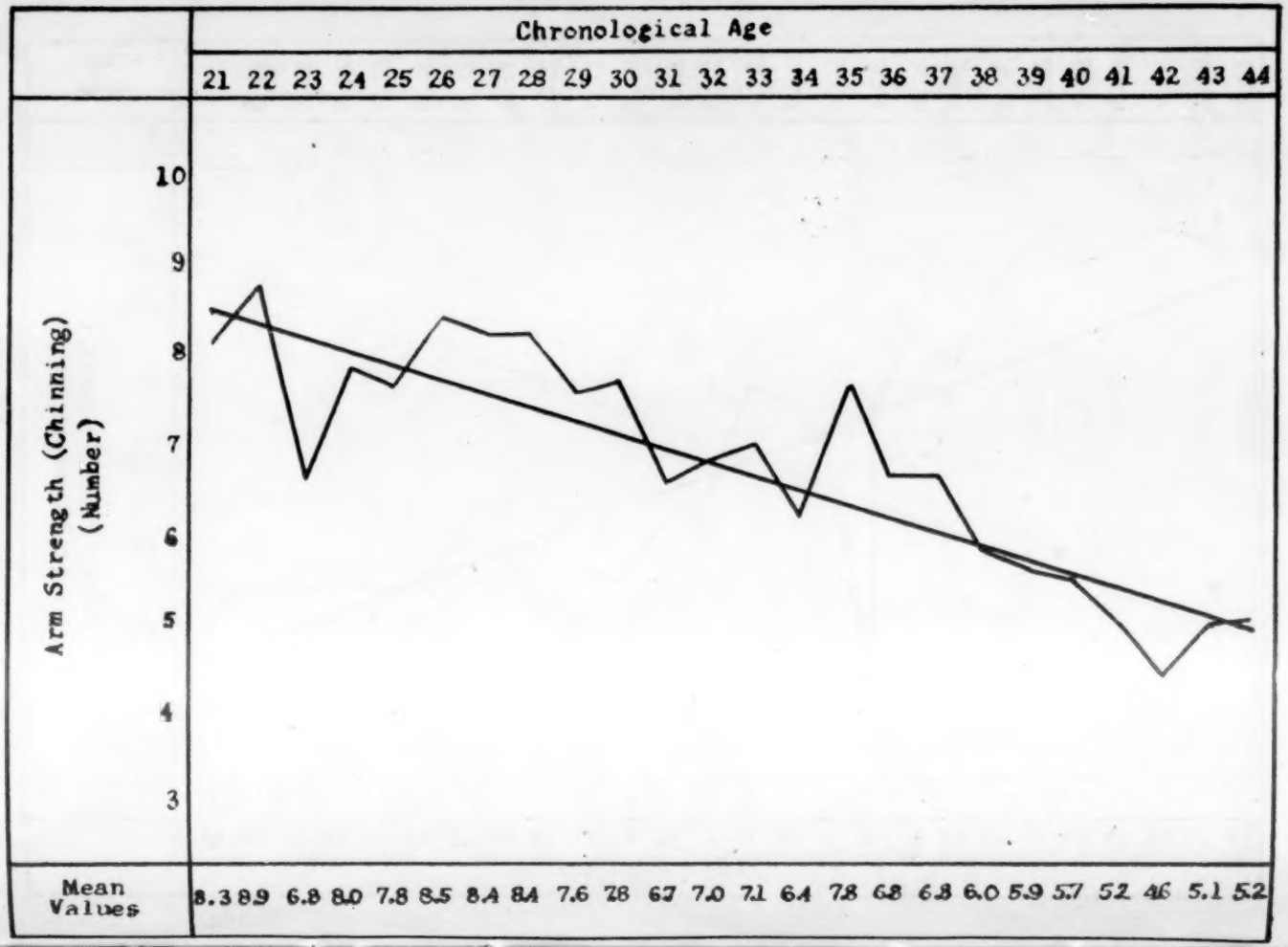
GRAPH III. CHRONOLOGICAL AGE AND SPEED (60-YARD DASH).



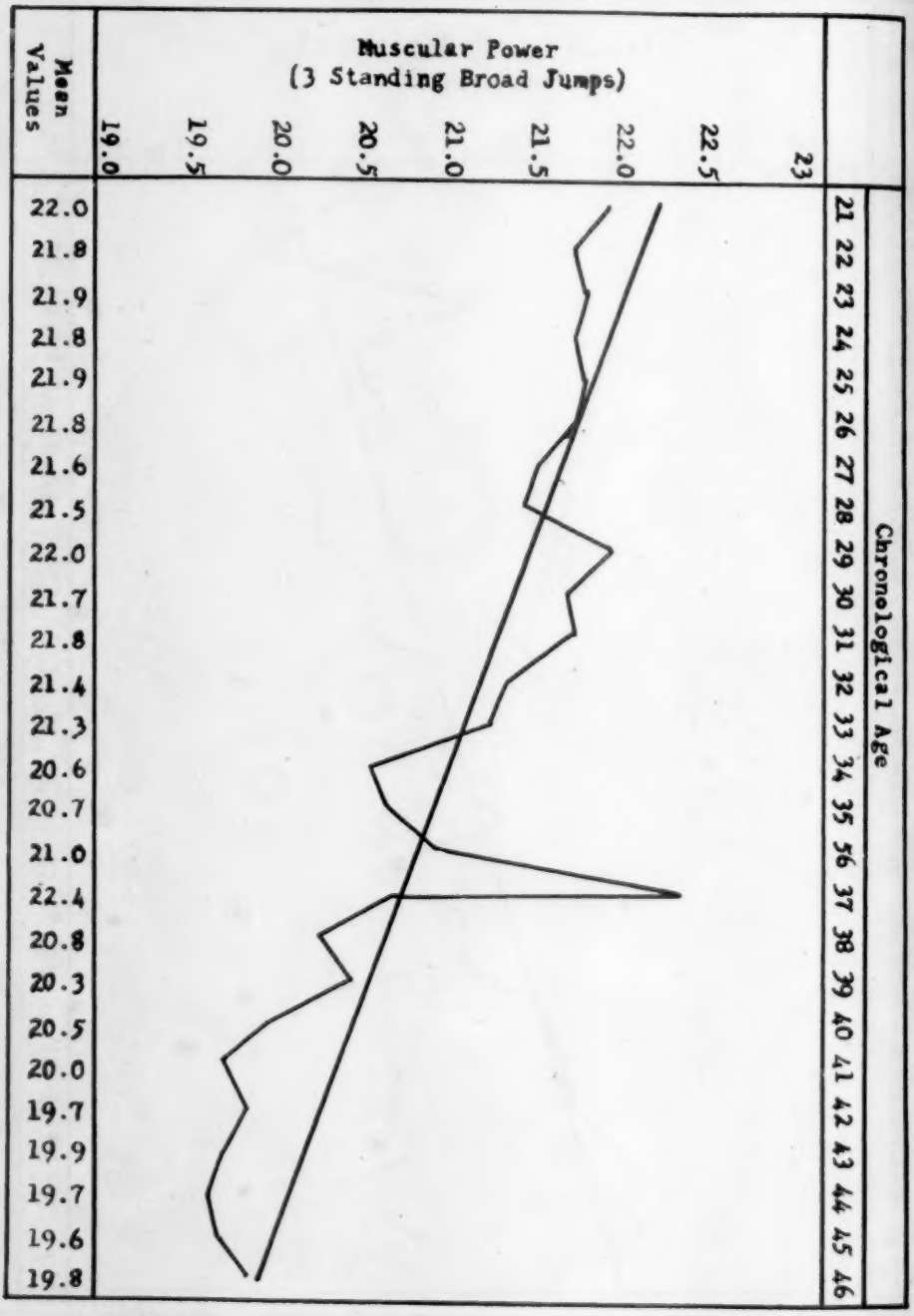
GRAPH IV. CHRONOLOGICAL AGE AND ABDOMINAL STRENGTH (SIT-UPS).



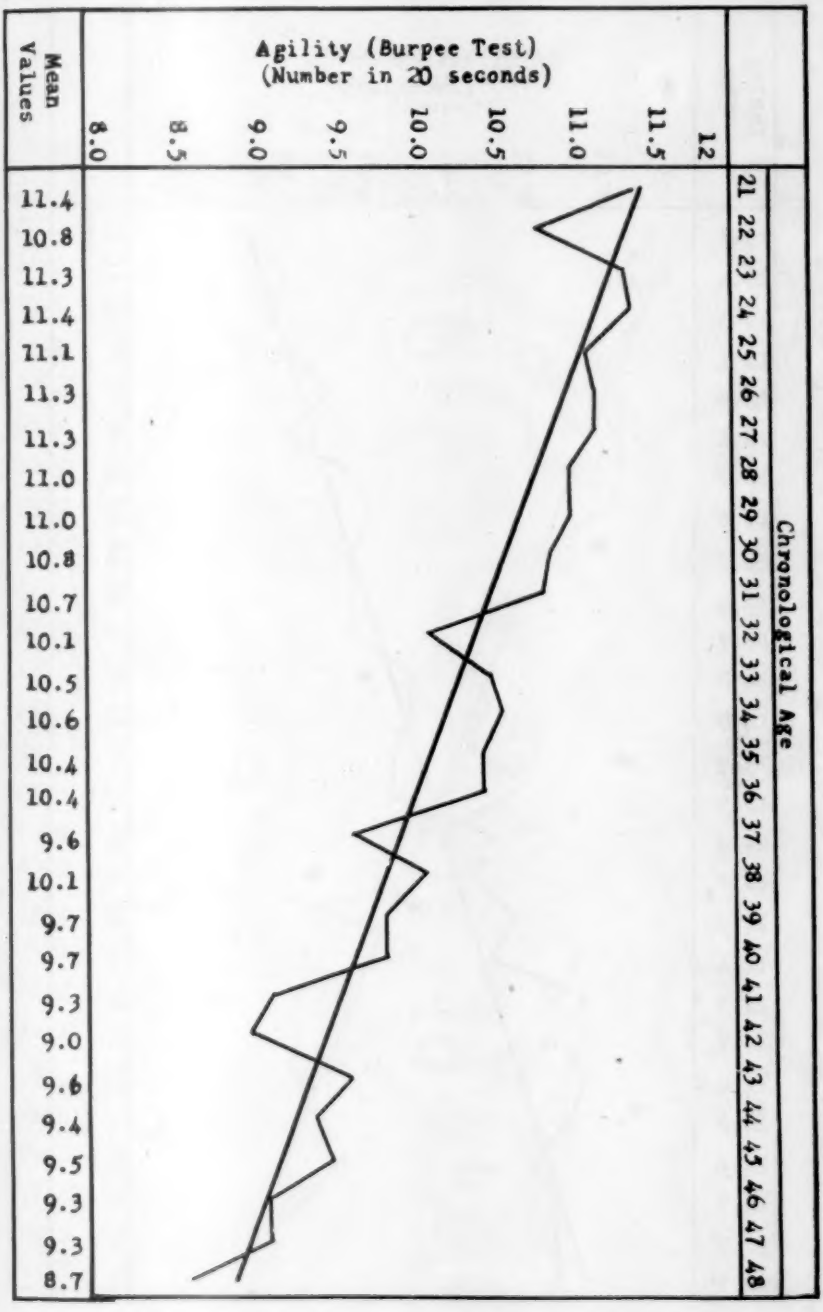
GRAPH V. CHRONOLOGICAL AGE AND ARM STRENGTH (CHINNING).



GRAPH VI. CHRONOLOGICAL AGE AND MUSCULAR POWER (3 STANDING BROAD JUMPS).

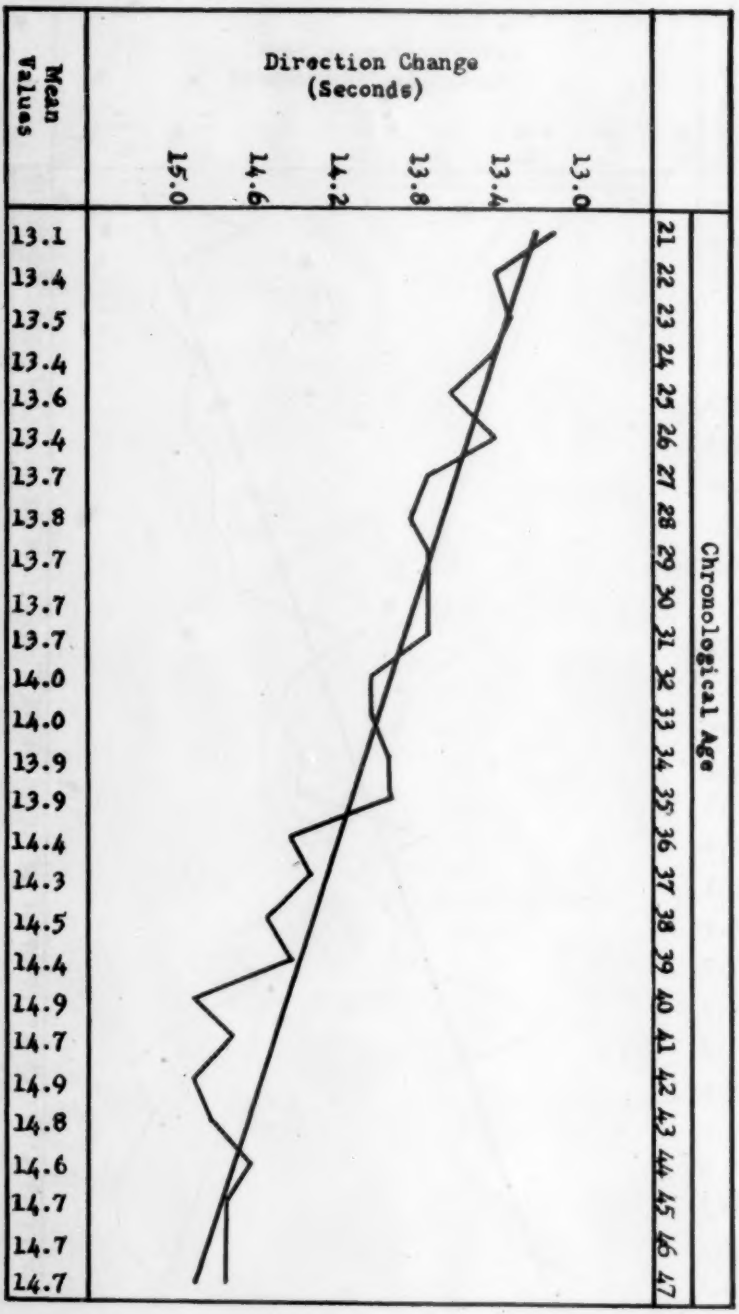


GRAPH VII. CHRONOLOGICAL AGE AND AGILITY (BURPEE TEST).

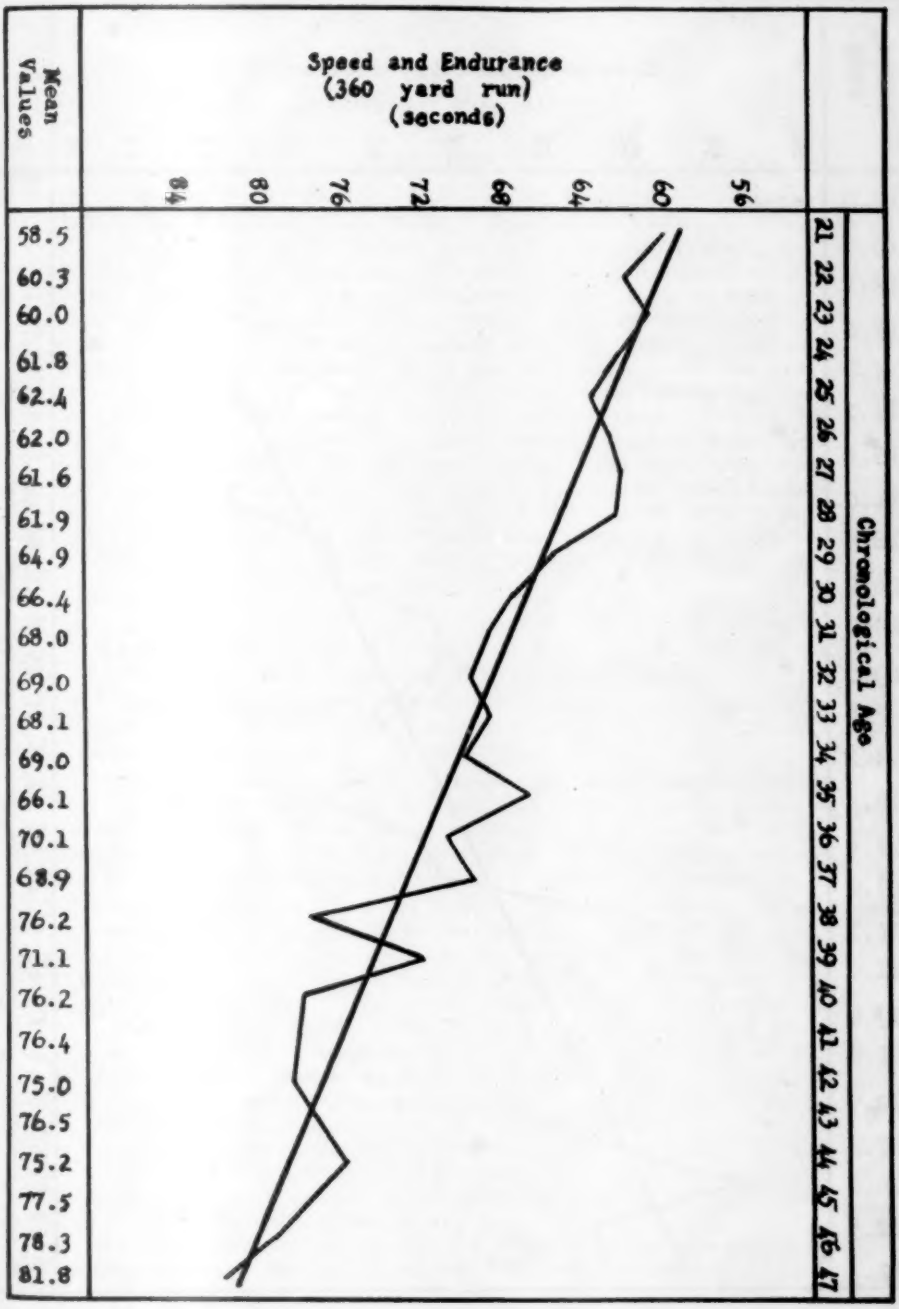


Chronological Age

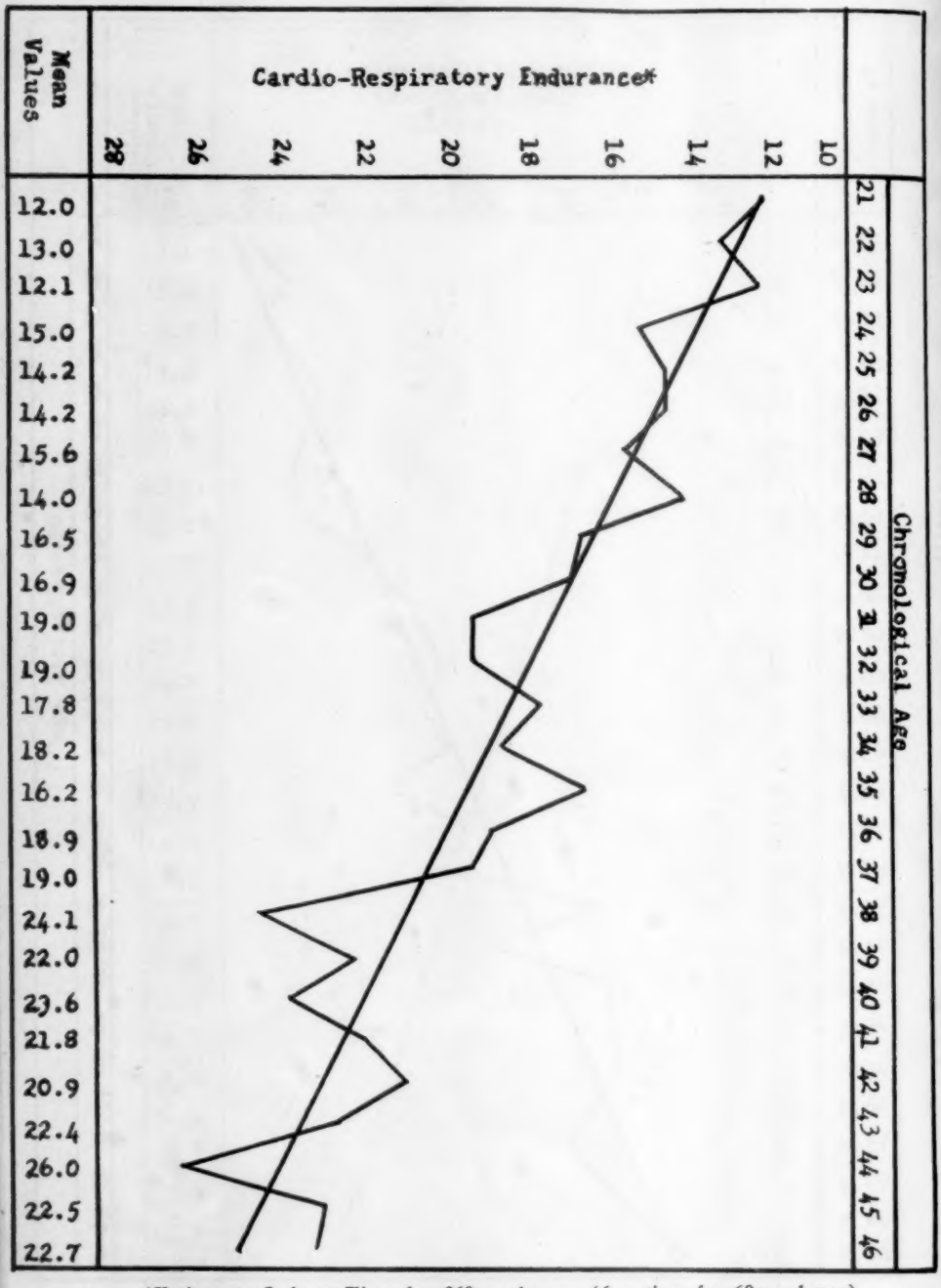
GRAPH VIII. CHRONOLOGICAL AGE AND DIRECTION CHANGE.



GRAPH IX. CHRONOLOGICAL AGE AND SPEED AND ENDURANCE (360-YARD RUN).



GRAPH X. CHRONOLOGICAL AGE AND ENDURANCE.*



*Endurance Index = Time for 360-yard run—(6 x time for 60-yard run).

Research Abstracts

Prepared for the

NATIONAL COUNCIL OF THE RESEARCH SECTION

By GRANVILLE B. JOHNSON

NUTRITION

Stewart, Aubrey P., Jr. "Vitamin C Content of Market Milk, Evaporated Milk, Powdered Milk, Whole Milk," *J. Nutrition*, 31:2 (February, 1946).

A comprehensive survey has been made to determine the vitamin C content of dairy products produced and sold commercially. Both reduced ascorbic acid and dehydroascorbic acid were measured and the sum of the two considered total vitamin C. Analytical procedures were employed which were specific for vitamin C and did not include interfering, reducing substances. Pasteurized milk from consumers' homes and retail stores in the San Francisco-Oakland-Berkeley Bay Region averaged 5.8 mg. total vitamin C per liter (364 samples), of which 3.4 mg. was in the reduced ascorbic form. Fresh spray process, powdered, whole milk, from commercial plants in various parts of the country, averaged 12.5 mg. total vitamin C per liter reconstituted (2,890 samples), almost all of which were in the reduced form. Samples stored at room temperature, air packed, retained 88.7, 85.5 and 79.8% of their vitamin C content after 3, 6, and 12 months respectively. Raw milk entering the manufacturing plants averaged 17.1 mg. reduced ascorbic acid per liter (1,050 samples).—*The Wistar Institute.*

Forbes, Ernest B., Raymond W. Swift, Ralph F. Elliott, and William H. James. "Relation of Fat to Economy of Food Utilization: I. By the Growing Albino Rat," *J. Nutrition*, 31:2 (February, 1946).

A 70-day metabolism and body-analysis experiment was conducted to determine the differences in the fat content of isocaloric diets on the utilization of food energy and protein.

The subjects were four groups of ten, growing, male, albino rats, each of these four groups containing one rat from each of the same ten litters. A comparison was made of four diets containing 2, 5, 10, and 30% of fat, respectively, these diets being so compounded and fed as to supply to each rat of a litter the same quantities of gross energy, protein, and vitamins.

Determination was made of the gains in life weight, nitrogen, and fat and energy, with a single value of the heat production for the 70 days as the energy of the food minus the energy of the excreta and of the body gain. The gains in live weight, the digestibility of nitrogen, and the retention of nitrogen and energy were in the order of the increasing fat content of the diets, the superiority of the 5% to the 2% fat diet with respect to the utilization of both protein and energy being much greater than the superiority of the 30% as compared with the 5% diet.—*The Wistar Institute.*

———. "Relation of Fat to Economy of Food Utilization. II. By the Mature Albino Rat," *J. Nutrition*, 31:2 (February, 1946).

Respiration experiments were conducted by the open-circuit, Haldane respiratory-quotient procedure, with 48 mature albino rats as subjects, to investigate the energy expense of utilization (heat increment) of complete diets as affected by their contents of fat.

Heat increments were measured as the difference in heat production from maintenance diets containing 2, 5, 10, and 30% of fat, respectively, fed so as

to supply equal growth experiment in which the same diets were fed. The digestibility and the retention of food nitrogen were highest when the diet containing 30% of fat was used. The metabolizable energy of the diets was unaffected by their fat contents. The heat production of both planes of nutrition and also the heat increments diminished in the order of the increasing fat contents of the diets.

The heat increments of the dietary supplements containing 2, 5, 10, and 30% of fat, respectively, were equivalent to 36, 31, 29, and 20%, respectively, of their gross energy. The decreasing energy expense of utilization of the isocaloric diets, in the order of their increasing fat contents, was due to decreasing heat from the catabolism of carbohydrate and from fat synthesis.—*The Wistar Institute.*

Briggs, Alfred P., Sam A. Singal, and Virgil P. Sydenstricker. "A Study of Nicotinic Acid Restriction in Man," *J. Nutrition,* 29: 5 (May, 1945).

Two subjects, each of whom previously had been a pellagra patient, restricted themselves to a diet low in trigonelline and providing only about 3 mg. nicotinic acid daily, one for a period of 9 weeks and the other for 42 weeks. Each had minimal lesions of nicotinic acid deficiency at the start, but in neither was there any significant development in the direction of pellagra. The nicotinic acid excretion of one remained low throughout the study; the other remained at a normal level. The trigonelline output in each case dropped to a low level within 3 weeks, but showed no tendency to fall to a lower level with prolonged restriction. Niacin tolerance tests in each case were interpreted to indicate a mild state of deficiency. Tests for the fluorescent substance F_2 were zero at the start as well as at the close of the periods of restriction. It is suggested that the failure in the development of pellagra may have been due possibly to intestinal biosynthesis of nicotinic acid, and possibly to the fact that the diet contained no corn. Apparently, under the conditions of this study, the 3 mg. daily of the diet provided an intake somewhere near the minimal niacin requirement.—*The Wistar Institute.*

Parsons, Helen T., Anne Williamson, and Mary L. Johnson. "The Availability of Thiamin from Yeasts: I. The Absorption of Thiamine by Human Subjects From Various Types of Bakers' Yeast," *J. Nutrition,* 29: 6 (June, 1945).

The availability of thiamine from six samples of bakers' compressed yeast was determined by thiamine elimination of twenty-three human subjects. The yeasts were fed both fresh and after boiling in portions containing 1.0 to 3.7 mg. thiamine daily. As in earlier results on similar yeasts, types containing 0.5 mg. thiamine per cake, were distinctly less well utilized as thiamine sources when fed fresh than after boiling; urinary thiamine was even diminished below that on the basal diet by feeding these yeasts fresh, unboiled. Thiamine not accounted for in urinary excretions could largely be found in the feces; living yeast cells were recovered from the stools after fresh yeast feeding. Four yeast samples of higher vitamin content did not show the previously observed effect of lowering urinary thiamine when fed fresh, but, instead, led to varying increases in output; the fresh yeasts most notable in increasing urinary thiamine were the ones highest in vitamin content. The explanation for the observed differences is undetermined; neither strain nor amount of yeast fed appears significant.—*The Wistar Institute.*

EDUCATION

Blayne, Thornton. "Retention of Skills Acquired in Developmental Reading Programs," *School and Society,* 63: 1620 (January 12, 1946).

Fifty pupils of the 9th, 10th, and 11th grades of the Menlo School and Junior College were rechecked for skill gained by special reading training.

With so few cases, only trends were indicated by the author. It appeared that speed of comprehension can be built rapidly in a relatively short time. Reading power tends to remain at its higher level or to increase.

Of interest is the fact that pupils tend to recommend work in developmental reading to other pupils.—*Carolyn Bookwalter.*

Burton, Philip W., "Newspaper Reading Behavior of High School Students," *School and Society,* 63; 1623 (February 2, 1946).

The recognition method of study was used to measure the daily reading behavior of the senior high school students at the Palo Alto (California) Senior High School.

From a self-estimate analysis it was found that 52% of the girls thought they obtained their knowledge from the radio while 28% named the newspapers. Of the boys, 62% thought they obtained their information from the radio while 33% named the newspapers.

On the day of the interview it was found that 98% had read the newspapers that day whereas only 42% had listened to the news over the radio.

Of more interest to the boys and girls were the departments of graphics and comics, with slightly less interest in war news and sports.—*Carolyn Bookwalter.*

Gemmell, James. Has Education Kept Pace with Changing Occupational Trends?" *School and Society,* 63: 1626 (February 23, 1946).

From the U. S. Office of Education records it was found that for the age group 16 through 19 the high schools are training an excess of 94% of employable bookkeepers and an excess of 82% of employable shorthand writers but are training a shortage of 393% of employables in the selling field. It was concluded that school enrollments in retailing must be increased because this is the logical way to prepare students for current employment opportunities.—*Carolyn Bookwalter.*

Park, Joe. "How They Thought They Were Motivated," *J. Educ. Research,* 34: 3 (Nov., 1945).

Fifty-four high school and ninety-three university students participated in the study of techniques used in motivating students by writing descriptions of techniques used by elementary and high school teachers. Data were classified in the following categories of techniques of motivation: competition, rewards, prizes; audio-visual aids; teacher personality; miscellaneous. The author concludes that no one technique is adequate and, as has long been recognized, teacher personality is a vital factor in creating a desire to learn on the part of the student.—*Helen Coleman.*

Remmers, H. H. "Changes in Attitudes Toward Germans, Jews, and Nazis as Affected by the War," *School and Society,* 63: 1625 (February 16, 1946).

Attitude scales were included in the general examinations given college sophomores at Purdue University in 1935, 1942, and 1945. The numbers of students tested were: in 1935—131, in 1942—172, and in 1945—335.

No substantial change in average attitude toward Germans and Jews over the past ten years was found. A steady increase was found in the variability in attitudes toward the Nazis and Japanese over the ten-year period which was especially noticed with the onset of the war. The attitude toward the Jews showed the greatest variability.—*Carolyn Bookwalter.*

Schreiber, Paul R. "Measurement of Growth and Adjustment After Four Years of High School," *J. of Educ. Research,* 34: 3 (Nov., 1945).

An investigation to determine the amount of change manifested on the Stanford Achievement Test and Symonds Adjustment Questionnaire was made of fifty-three students. Tests were given to first-year students in 1937 and again in the senior year in 1941. A critical ratio of 5.34 was sufficiently high

to show a significant change. Data were tabulated to show manifestations in different parts of tests and indicated outstanding changes in spelling and hygiene. The over-all view indicated that better students began high school better adjusted than did poorer students but tended to be less adjusted as seniors as their viewpoint became more critical of environments. Poorer students tended to remain static in their adjustments. The author suggests that much is yet to be accomplished in social adjustments and social adequacy if good citizenship is to remain an educational objective.—*Helen Coleman.*

PHYSICAL EDUCATION

Fulton, Ruth E. "Speed and Accuracy in Learning Movements," *Archives of Psychology,* 300 (June, 1945).

The purpose of this study was to estimate some of the effects on motor performance resulting from emphasis upon speed or upon accuracy in the initial trials of training. An additional purpose was to compare the results obtained from a movement which is primarily ballistic with those obtained from a movement which is primarily non-ballistic.

Two experiments were conducted. One experiment used a tracing movement (non-ballistic); the other used a striking movement (ballistic). The tracing experiment was extended as an experiment in relearning after a five-week interval.

In general, the procedure was as follows. Initial status in speed and accuracy was determined by trials in which the instructions stressed general procedure of performing the task, but did not mention speed or accuracy. The initial trials were followed by a training period in which one group was instructed to stress speed and the other to stress accuracy. In the post-training period both speed and accuracy were emphasized.

Early emphasis upon speed in learning a movement was found to be more advantageous than early emphasis upon accuracy. This was true in both types of movements used.—*Ruth E. Fulton.*

MEDICINE

Zanfagna, Capt. Philip E. "Perennial Bronchial Asthma, "*Bulletin of the U. S. Army Medical Department,* 87: 100 (April, 1945).

A study was made of the first one hundred cases of bronchial asthma diagnosed and treated in the allergy wards of a station hospital. During the first eight months of 1943, 305 soldiers were seen in acute or chronic attacks of asthma. This station represented one of about 1,000 Army posts and Army Air Forces stations in the continental United States.

This series of 305 cases comprised soldiers from 19 to 42 years of age, the average age being 28 years, of whom 51 developed symptoms in the first decade of life. Nine admitted the onset to be subsequent to pertussis; eight followed pneumonia; one patient developed asthma shortly after a tonsillectomy.

Despite careful induction examinations, the incidence of asthma in the Army was found to be high. Psychic factors were found to play an important role in the reproduction of attacks in predisposed individuals. Specific or etiologic treatment was found to be overlooked or ignored by the general practitioner. Prognosis was concluded to be determined by the complications. —*Cecil C. Franklin.*

PHYSIOLOGY

Andrew, Warren. "Senile Changes in the Pancreas of Wistar Institute Rats and of Man with Special Regard to the Similarity of Locule and Cavity

Formation," *Am. J. Anat.*, 74: 1 (January, 1944).

A study has been made of the pancreas of seventy-four Wistar Institute rats ranging from youth up through extreme senility. A definite series of changes in this organ in old age has been found. Studies of the human pancreas, made upon sections from fifty-five individuals, show a similar process with age in man.

The senile change in this organ consists of a proliferation of duct-cells of both the interlobular and intralobular (intercalated) ducts, at first as more or less solid masses. Later lumina are formed and by their expansion form locales which are either solitary or multiple. Such locules are lined by extremely flattened epithelium and in man may have been mistaken for intralobular "adipose tissue invasion" by earlier workers.

The thin-walled locules, both in rat and man, frequently rupture, forming large, irregular cavities. Some of the locules contain a material which resembles keratin.

Alveoli of entire lobules or of large portions of lobules eventually are replaced by locales and irregular cavities. The islets of Langerhans atrophy secondarily to the locale formation. True adipose tissue invasion occurs finally as a replacement phenomenon.

The process of locule formation is extensive in all of the older individuals studied. Metaplasia in the interlobular ducts apparently is only one manifestation of the tendency for duct-cells to proliferate and become squamous in type.—*The Wistar Institute.*

Brues, Alice M. "A Genetic Analysis of Human Eye Color," *Am. J. Phys. Anthrop.*, 4: 1 (March, 1946).

Observations of eye color and the structure of the iris were made on 300 white Americans comprising 83 groups of siblings. Analysis was made on the basis of sibling pairs.

The type of eye most distinct genetically is that in which the anterior layer of the iris is smooth and complete, and partially or entirely brown in color. In contrast to this is the iris in which the anterior layer is atrophied to a greater or less extent. The latter type varies from pure light to (rarely) pure dark. The Light eye is a sex-linked recessive to which the atrophied non-Light types are dominant. Yellow pigment and brown pigment in these non-Light eyes are genetically very distinct. The rare Dark type of the atrophied iris is a recessive, unrelated to the smooth pigmented eye, which is apparently dominant to all other types. A sex-linked factor is also involved in the degree of atrophy of the anterior layer, the scalloped or fully atrophied type being dominant to the cryptose or partially atrophied type.—*The Wistar Institute.*

PHYSICAL ANTHROPOLOGY

Bullen, Adelaide K., and Harriet L. Hardy. "Analysis of Body-Build Photographs of 175 College Women," *Am. J. Phys. Anthrop.*, 4: 1 (March, 1946).

This report presents a tabulation method of somatotyping using specific observable points taken directly from Sheldon. One hundred and seventy-five body-build photographs of college women have been somatotyped, analyzed, and the findings compared with Sheldon's series of 4,000 college men, Dupertuis' 1,000 Harvard men, and Sheldon's bromide silhouettes of 2,500 women students. The percentage incidences of the specific criteria are listed and briefly discussed.

It is suggested that the range of dysplasia is greater in women than in men. Also the findings suggest that certain morphological characteristics

which have been designated as "male" and "female" by some investigators may correlate with variables other than sex *per se*.—*The Wistar Institute.*

ANATOMY

Elftman, Herbert O. "Torsion of the Lower Extremity," *Am. J. Phys. Anthrop.*, 3: 3 (September, 1945).

The torsion of the femur of the adult varies independently of the torsion of the tibia; it is consequently impossible to predict one from the other. The angle of foot deviation increases with the torsion of the tibia, but more slowly. The relative orientation of the neck of the femur and of the axes of the knee and ankle joints is of importance in locomotion and in foot mechanics. The progressive increase in both femoral and tibial torsion during fetal life is well established. The femoral torsion at birth is much greater than it is in the adult, while the torsion of the tibia is smaller than the adult value. The ages at which adult conditions of torsion are reached have not yet been accurately determined, and the factors which influence the changes in torsion await adequate evaluation.—*The Wistar Institute.*

Lassek, Arthur M., and Joseph P. Evans. "The Human Pyramidal Tract: XII. The Effect of Hemispherectomies on the Fiber Components of the Pyramids," *J. Comp. Neur.*, 83: 1 (August, 1945).

In a series of three cases of human hemispherectomies which survived the operations for 11, 21, and 330 days, it was found in the longest surviving individual that fibers other than those originating in the cerebral cortex may course through the pyramid either in an anteroposterior or descending direction. The former are more numerous and are apparently normal, myelinated fibers often associated with the blood vessels of the pyramid. Their source is probably from the nuclei gracilis and cuneatus of the opposite side. In addition to these fibers, there are others, insignificant in number, small in caliber, and scattered which course in a longitudinal direction. From the material at hand, we have not been able to determine the source of these fibers.—*The Wistar Institute.*

Bridgman, Charles S., and Karl U. Smith. "Bilateral Neural Integration in Visual Perception After Section of the Corpus Callosum," *J. Comp Neur.*, 83: 1 (August, 1945).

Experiments concerning visual space and movement perception in patients with partial and complete section of the corpus callosum have proven that perceptual capacities of this sort which depend on bilateral integration in the centers of the nervous system are not materially affected by the operations. The capacities include binocular depth perception, as determined by both homonymous and heteronymous types of fusion, the ability to maintain and recover fusion in response to diplopia-producing stimuli, and monocular, apparent-movement vision induced by stimulation of two points, one in each lateral half of the retina.

The data suggests that some minor deficit in the divergence and convergence necessary to maintain and recover single binocular vision ensues as a result of the operations.

The results offer evidence that the commissural systems lying between the cerebral cortices in man are not indispensable in the determination of space vision and movement vision assumed to require bilateral interaction between visual centers in the two sides of the brain. In terms of the data obtained, the locus of such interaction is concluded to occur subcortically, and to be related to the midbrain centers indispensable for the mechanism of convergence and divergence which are dynamically associated with the phenomena of binocular space discrimination.—*The Wistar Institute.*

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THE Editorial Committee has approved the following policies for the publication of material in the *Quarterly:*

1. Manuscripts should be sent to the Editor who will see that each one is read by at least two members of the Board of Associate Editors. The Editor will advise the author as to the suitability of the paper or the desirability for revision.

2. Papers are not judged by arbitrary standards of length but on their content of new research results in the field of physical education, health education, and recreation, presented with the greatest brevity compatible with scientific accuracy and clarity.

3. Since manuscripts will not be insured against loss or damage, authors are expected to retain duplicate copies of all material submitted.

4. An original typewritten copy of the manuscript should be submitted. The content should be double spaced with a margin of 1½ inches on each side.

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1 Katherine B. Crisp, *Health for You*, p. 520. (books)

2 Stern, Francis. *Applied Dietetics.* Baltimore: William and Wilkins Company, 1943. (books)

3 Corbin, H. D., "Current Problems in Recreation," *Journal of Health and Physical Education*, 15:6 (June, 1944), pp. 315-16, 353-54. (magazines)

4 Kraines, S. H., and E. S. Thetford. *Managing Your Mind.* New York: The Macmillan Company, 1944.

Although this form is preferred in the *Quarterly*, authors may submit articles with references prepared differently provided the essential information is given and the style used is that of well known journals.

There are many sources of information relative to the preparation of manuscripts for publication. A good source is *A Manual of Style* (10th Edition), Chicago, University of Chicago Press, 1937.

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ERRATUM

On the reverse side of this page will be found a reset of page 41 of the March Research Quarterly which was incorrectly set up. This is part of the article by Dr. Ross Wedemeyer. The page may be torn out of this issue and pasted into the March issue.

All the boys had recent had a physical examination. Only boys who had no handicapping physical defects were used.

The following three tests were given with equipment as listed:

Tests Administered	*Equipment*
1. Total number of sit-ups each boy could do in two minutes at his own rate of speed.	Stall bars, mat 6′x10′, stop watch.
2. Total number of sit-ups unlimited time, at a rate of one sit-up each two seconds.	Stall bars, mat 6′x10′, metronome.
3. Test for sit-up strength using the Martin Breaking Strength Method. Data as recorded on the individual data card (Figure 1) were collected for each boy.	2 small pulleys arranged as a "block and tackle," a 2″ web strap 6′ long. A hand dynamometer with attachments for pulling, 1 mat 6′x10′.

The first time the tests were administered was during the week of January 22, 1945.

A DIFFERENTIAL ANALYSIS OF SIT-UPS FOR STRENGTH AND MUSCULAR ENDURANCE

Name.....
School.....
Date.....
Age..... Born..... (year..... month..... day.....)

	First Test	*Date*	*Second Test*	*Date*
Height				
Weight				
Sitting-Up Height				
Chest Girth				
Sit-Up in 2 min.				
Total Sit-Ups Limit (Unlimited Time)				
Sit-Up Strength				

First Test		*Second Test*	
2 min.	Unlim.	2 min.	Unlim.

Remarks:

$$\frac{\text{Chest Girth}}{\text{Height}} \quad \frac{\text{Chest Girth}}{\text{Sitting Height}} \quad \frac{\sqrt[3]{\text{weight}}}{\text{height}}$$

Fig. 1. Individual Data Card.

Test 1. Two-Minute Situps.—Instructions were given to each individual that he was to do as many sit-ups in two minutes as he

**These were students of the University Experimental High School at the University of Iowa, Iowa City, Iowa.